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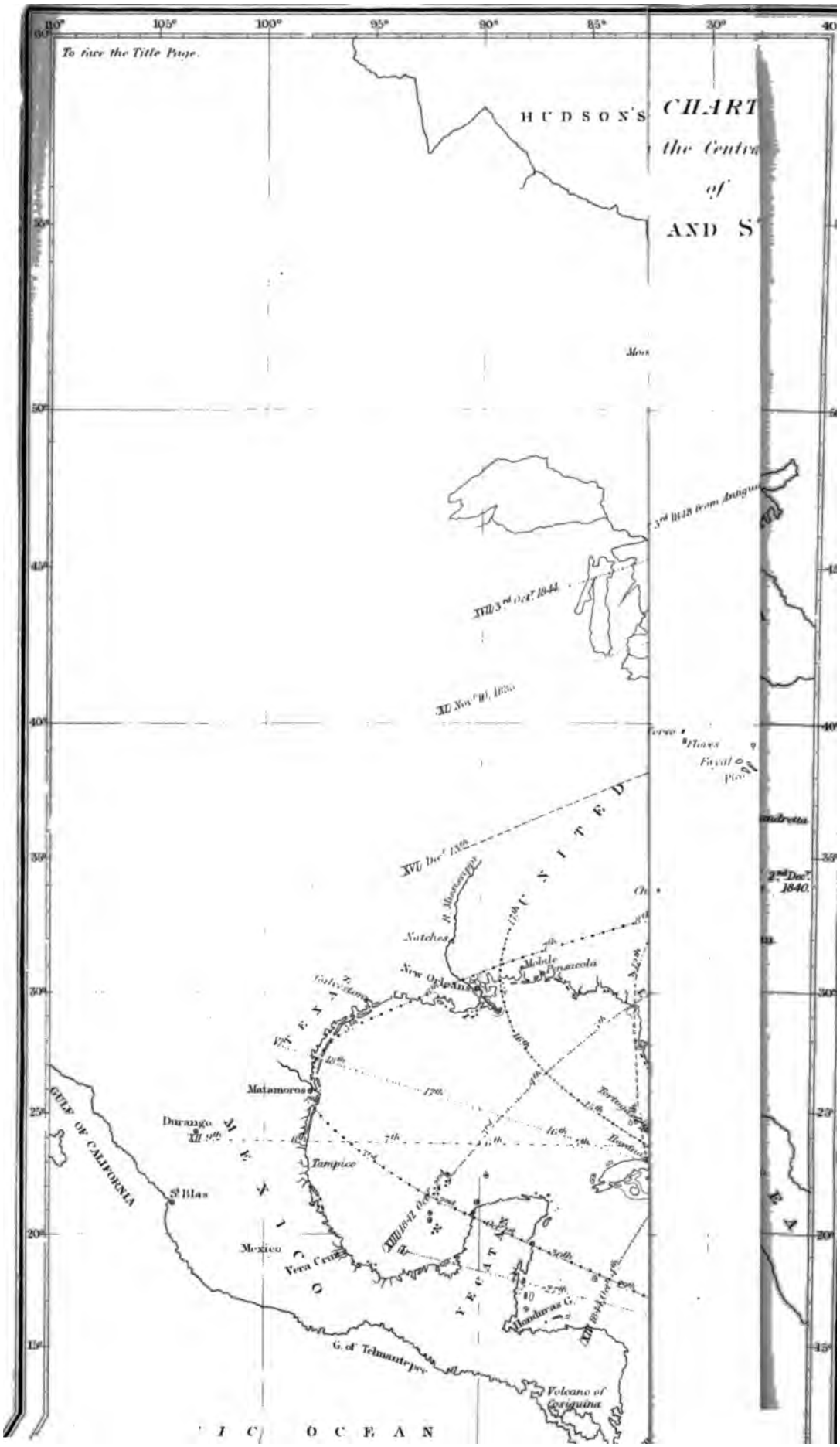
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I C O C E A N

THE PROGRESS

OF THE

DEVELOPMENT

OF

THE LAW OF STORMS,

AND OF

THE VARIABLE WINDS,

WITH

THE PRACTICAL APPLICATION OF THE SUBJECT

TO

NAVIGATION.

ILLUSTRATED BY CHARTS AND WOOD-CUTS.

BY LIEUT.-COLONEL WILLIAM REID, C.B., F.R.S.
(*Of the Corps of Royal Engineers.*)

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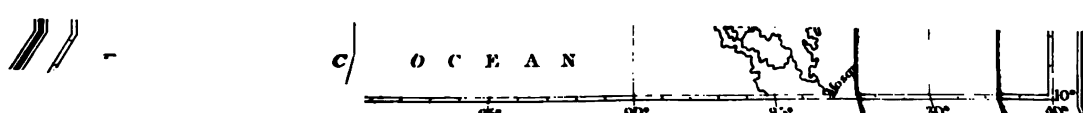

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Note.—The periodical work in which Mr. Piddington's Papers have been published, should have been styled "Journal of the Asiatic Society *of Bengal.*"

ON STORMS

AND

THE VARIABLE WINDS.

CHAPTER I.

Introductory Observations.

GENERAL EXPLANATION OF THE LAW OF STORMS.

THE object of this volume is to show the progress made in the development of the Law of Storms, and to point out how the same law accounts for variable winds, and for many of those changes of the wind which, until recently, have baffled explanation.

Had meteorologists continued to confine their observations to high latitudes and to single points, or to observations made on land only, we should probably never have been able to account for variable winds. But by beginning to study single storms near the Equator, and within the limits of the regular trade winds, following their tracks beyond the tropics into high latitudes, and observing how they cause changes of the wind, a highly important subject for investigation is opened.

Instances will be given of seamen profiting by the theory of storms, and I shall endeavour, as well as I can, to point out how advantage in sailing may be taken of the veering of the wind.

By collating a great number of reports of storms

CHAP. I.

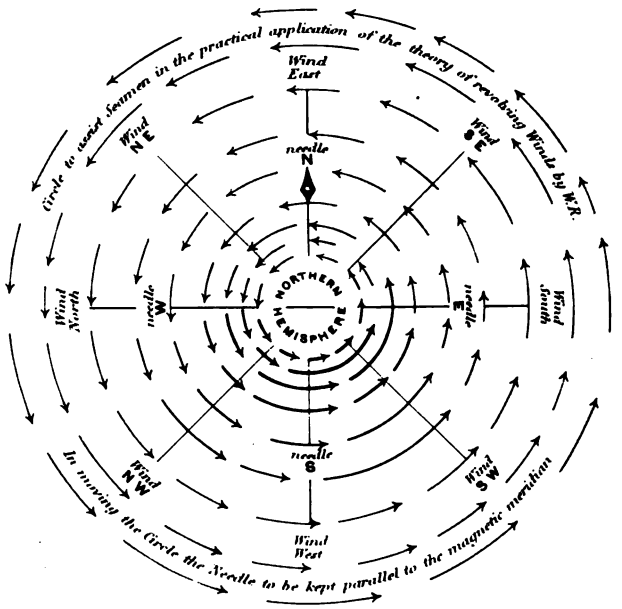
made at different places, as well at sea as on shore, the changes of wind in a separate storm are now understood. Mr. Redfield ascertained that storms in the northern hemisphere are vast whirlwinds with a progressive motion, revolving by a fixed law. It has also been proved that they revolve in opposite ways on opposite sides of the Equator, tending generally, although not always, obliquely towards the Poles. In their progress they must cause a variation of the winds during the time of their passage over a place on shore, or of a ship at sea, excepting where the centre of the whirlwind passes over, for there the change of wind will be directly to the opposite point.

The Tropical Hurricane has now been traced on the west side of the Atlantic, beyond the fiftieth degree of latitude, which is the latitude of the southernmost point of England, and has been proved to be a whirlwind whilst passing over Newfoundland towards Labrador. On the borders of the tropics other gales originate of various degrees of force. By their rotatory motion they neutralize or reverse the trade winds, and by their progressive movement they cause those changes of the wind, which give the name of "Variables" to certain latitudes. These latter winds, unlike the Tropical Hurricane, appear in the winter season to increase in force as they proceed, and to become the winter gales of high latitudes.

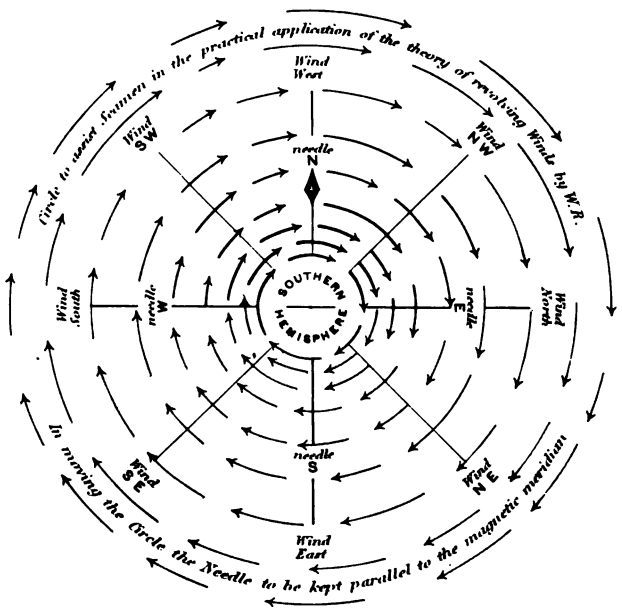
A residence of nearly eight years in the Bermudas, on the thirty-second degree of latitude, satisfied me that all the Bermuda gales, of whatever degree of force, *in which the wind veers and the barometer falls*, are progressive revolving gales; and I was struck when hearing the inhabitants call them "roundabouts."

To face page 3

LAW OF STORMS



EQUATOR

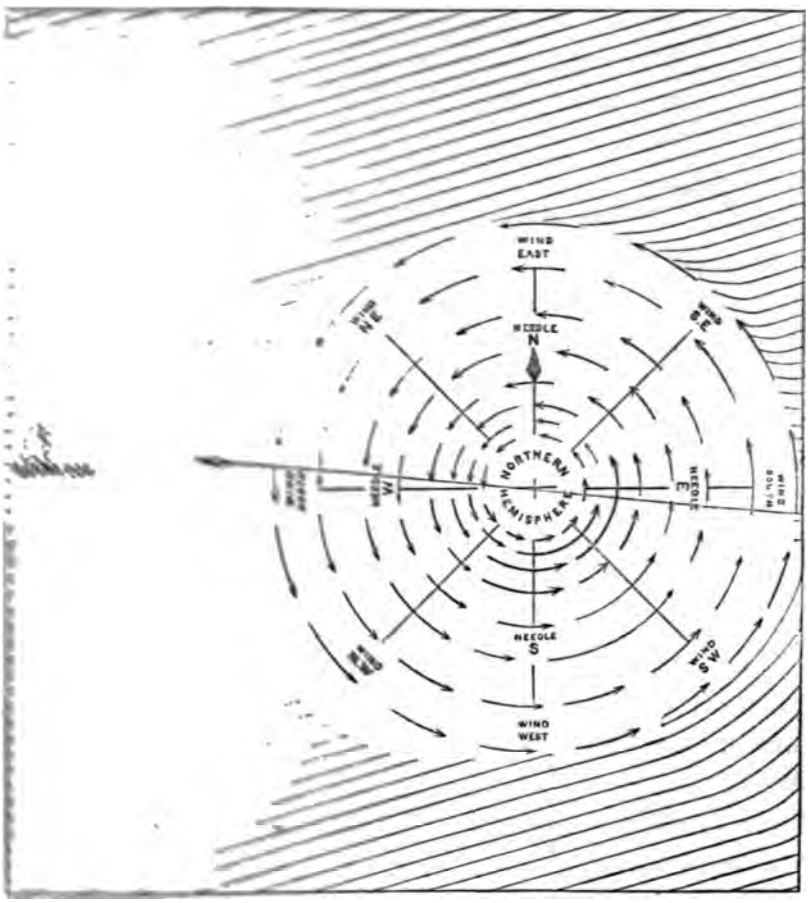


When these Circles are used they should be cut out and moved along a Marine Chart in the direction of a Storms progress.
Dipped in turpentine they will become transparent.

Lee John Weale, 59 High Holborn.

The progressive movement of whirlwind storms has been found varying from 43 miles to 3 miles an hour. There is reason to think they sometimes move still slower, particularly between the Tropics and the thirtieth degree of latitude, where they change their direction. When this takes place, their progressive movement may be almost suspended. Should it be altogether suspended, the barometer would remain stationary for the time, and the wind would cease to veer. The same effect would follow when a ship sails in a progressive whirlwind, at the same rate as the whirlwind moves onward, and maintains the same position with relation to the gale's centre. With such a ship the wind would continue to blow from the same point, and the barometer on board would be stationary.

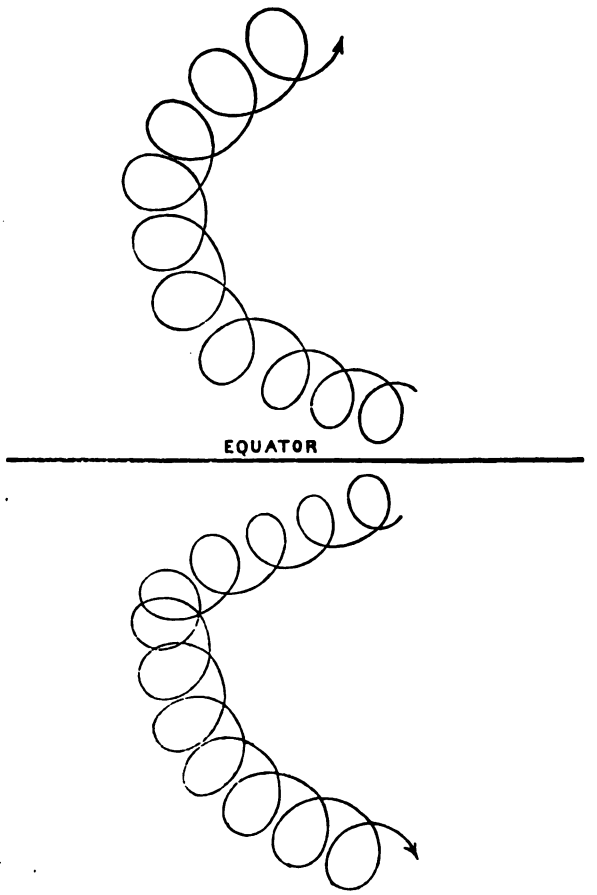
The circles annexed, made to assist seamen in the practical application of the theory of the revolving winds, show how gales revolve in either hemisphere. When these circles are placed on a marine chart, they serve to aid the memory whilst considering how the wind veers in whirlwind storms. For example, in the annexed diagram the trade wind is supposed to be blowing from the east-north-east, whilst a whirlwind hurricane is moving towards Barbados from the eastward, as shown by a spearhead. By moving such a circle onwards in the same direction until it reaches Barbados, the arrows of the storm circle will then represent the wind in the hurricane as setting in at north-by-east. If the entire circle be moved over Barbados, the arrows on the opposite side of the circle will represent the wind of the hurricane as ending at south-by-west.



Directions for the use of the storm circles have been engraved upon them, and, to render them more convenient, the paper on which they are printed may be rendered transparent.

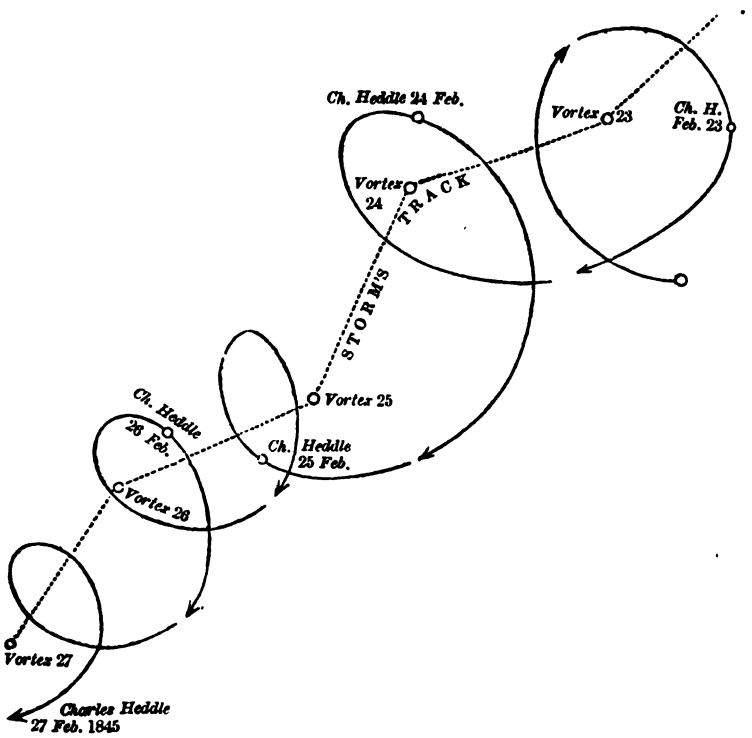
But the circle will only correctly represent a whirlwind when stationary. In the progressive whirlwind, the figure would become cycloidal, and the degree of curvature would depend upon the rate of progress of the storm. It has been found that the general course of storms is from the east towards the west whilst

within the Tropics. As they incline towards the Poles and reach the twenty-fifth and thirtieth degree of latitude, they generally recurve to the eastward, gyrating in opposite directions, somewhat in the manner of the following figure:—



The gyration of progressive storms in the southern hemisphere may be represented by an ordinary coil of rope somewhat opened out, and those of the northern hemisphere by a rope coiled in the contrary way.

CHAP. I. A remarkable proof of this mode of gyration is exhibited in the track of the brig Charles Heddle in a storm, which will be found described further on.



The direction of a wind in a whirlwind, supposing it to be circular, differs eight points from the points of the compass. A ship's bearing, therefore, from the centre of a whirlwind gale, may be known approximately by the direction from whence the wind blows at the time, as marked in whirlwind circles, but its distance from the centre of the gale cannot be ascertained. The falling or rising of the barometer will only indicate that a ship is approaching to, or receding from, the centre of a storm. Near the gale's centre

the wind veers rapidly, and caution is then required, lest a ship should be taken aback.

After a gale has passed over any fixed place, the direction in which it is moving is found by drawing a line from the point in the whirlwind circle, at which the gale commenced, to the point at which it ended. The line drawn across the figure at page 4, from north-by-east to south-by-west, shows the direction in which that hurricane is supposed to be moving.

On the approach of a revolving storm, the weather is sometimes calm, or the wind is unsteady, or *it may draw towards* the storm; and when this occurs it may be difficult to determine the exact point of the compass from whence the true whirlwind sets in. In like manner, it may not always be easy to determine the exact point at which a gale ends. Remarkable instances of this occur at Bermuda. After revolving gales, moving to the northward, have passed over the Bermudas, the wind very frequently continues veering from the north, towards north-north-east, but blowing lightly, with the barometer high.

Whirlpillars and Ripples.

The eleventh chapter of the attempt to develop the Law of Storms, was devoted to the subject of Water Spouts, or Whirl Pillars, as they are expressively called by the Germans. The whirlpillar causes a small whirlwind, but it must be regarded as a phenomenon of a nature entirely different to the extensive revolving wind which embraces several degrees of latitude and longitude. It has now been ascertained that the

CHAP. I.

whirlpillar revolves in either way in both hemispheres; and this peculiarity marks it as being in its nature a different phenomenon to the great storm. I have myself at Bermuda, along with several other spectators, observed them revolve in either way. Whirlpillars have now been observed in the midst of great revolving storms, of which I also witnessed one at Bermuda.

Whatever may be the phenomenon causing the whirlpillar, it would seem to be the same which causes those ripples disturbing the surface of the sea, which have often excited the curiosity of seamen. Horsburgh says, "that the ripples are frequently seen where there is no perceptible current, and that they are alarming to persons unacquainted with them, for the broken water makes a great noise, when a ship is passing through them in the night." He says, "that in calm weather they are seen approaching from a distance, and in the night their noise is heard a considerable time before they come near. They beat against the sides of a ship with great violence, and pass on, the spray sometimes coming on deck, and a small boat could not always resist the turbulence of these remarkable ripples."

Lieut. Frederick L. Barnard, R.N., compared their appearance to that of a boiling cauldron, or such as is formed by water being forced from under the gate of a mill-pond. Captain Basil Hall stated, that it was remarked, that when the ship got completely within the circuit of the ripple, the wind uniformly freshened, and that upon watching the phenomenon, it was distinctly made out, that at the same time a change occurred in its direction.

Whilst I have been myself watching the very curious

phenomenon of the whirlpillar when over the sea at Bermuda, I invariably observed near the spot, a considerable extent of agitated water, precisely resembling the description given of the ripples. From repeated observation I became impressed with the idea that the same cause produced both the ripple and the whirlpillar. On one occasion, observing a portion of the sea during a calm agitated in this manner, with a small dense cloud immediately over it, I earnestly watched them, and at the expiration of twenty minutes a small waterspout was distinctly developed from the cloud, and seen suspended from it immediately over the ripple. But whirlpillars are often developed without any cloud over them. I have observed them in a perfectly cloudless sky. Whatever the cause may be which creates them, I think it will be found by further observation, that it is the same cause which creates both it and the ripple; that they are one and the same phenomenon, but that the whirlpillar is only developed when the exciting cause has great energy.

It is now a well ascertained fact, that whirlpillars are developed in the midst of storms, and being small whirlwinds, turning in either direction, they may cause unexpected shifts of wind dangerous to ships. That they have sometimes great force, there is no doubt. Whilst I was at Bermuda a French vessel brought in the crew of a Spanish brig, which had been upset by a whirlpillar. The Spanish master explained to me that he was at the time under full sail, with a very light breeze and fine weather, when the brig in an instant was turned over by the whirlpillar. With great difficulty he and his crew extricated a boat, from which they were picked up by the French vessel.

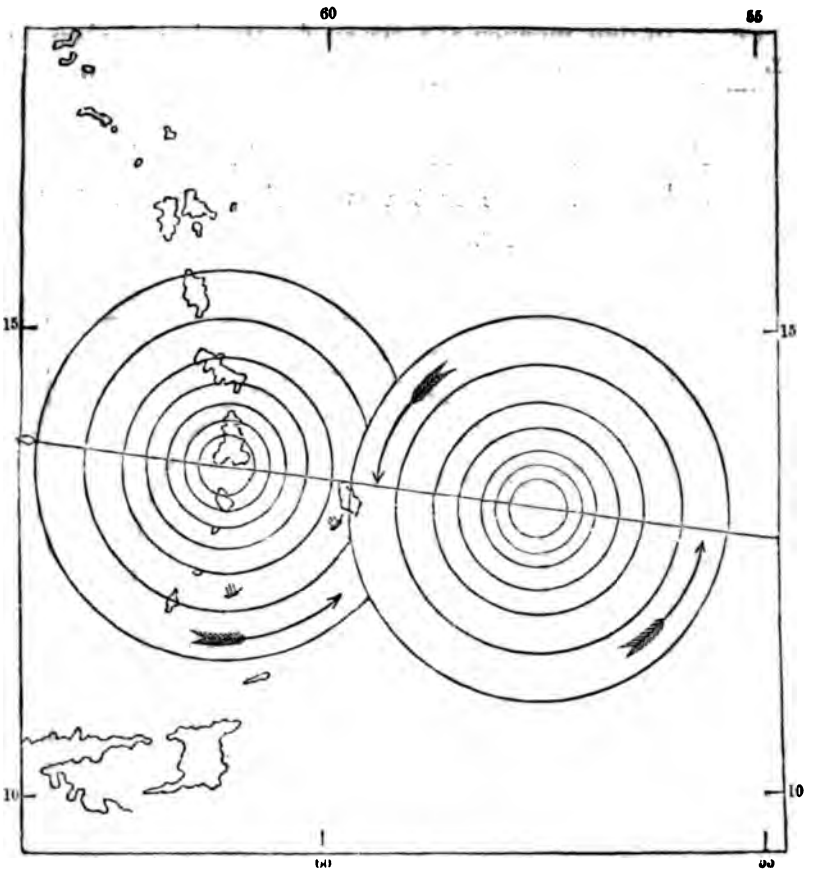
CHAP. I. I believe it to be the whirlpillar which carries up volcanic ashes into the upper atmospheric currents, in which they are sometimes carried along to great distances.

Tropical Storms on opposite sides of the Equator contrasted.

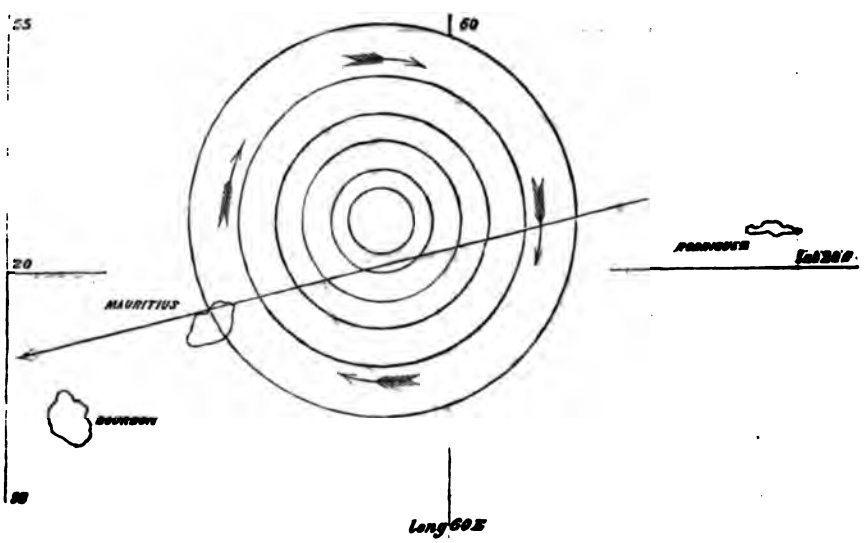
Navigators had long remarked that the changes of the wind and of the barometer were in a contrary direction in the southern hemisphere, to what they experienced in the northern hemisphere, without being able to refer this fact to any known Law.

I shall here place together diagrams representing storms on opposite sides of the Equator, in order that their counter-movements may the more easily be compared. The first diagram represents the Barbados Hurricane of 1831, compared with the Mauritius Hurricane of 1818, the first in north latitude, the second in south. Both were moving from the eastward, but revolving in opposite ways, and each was inclining towards its own pole.

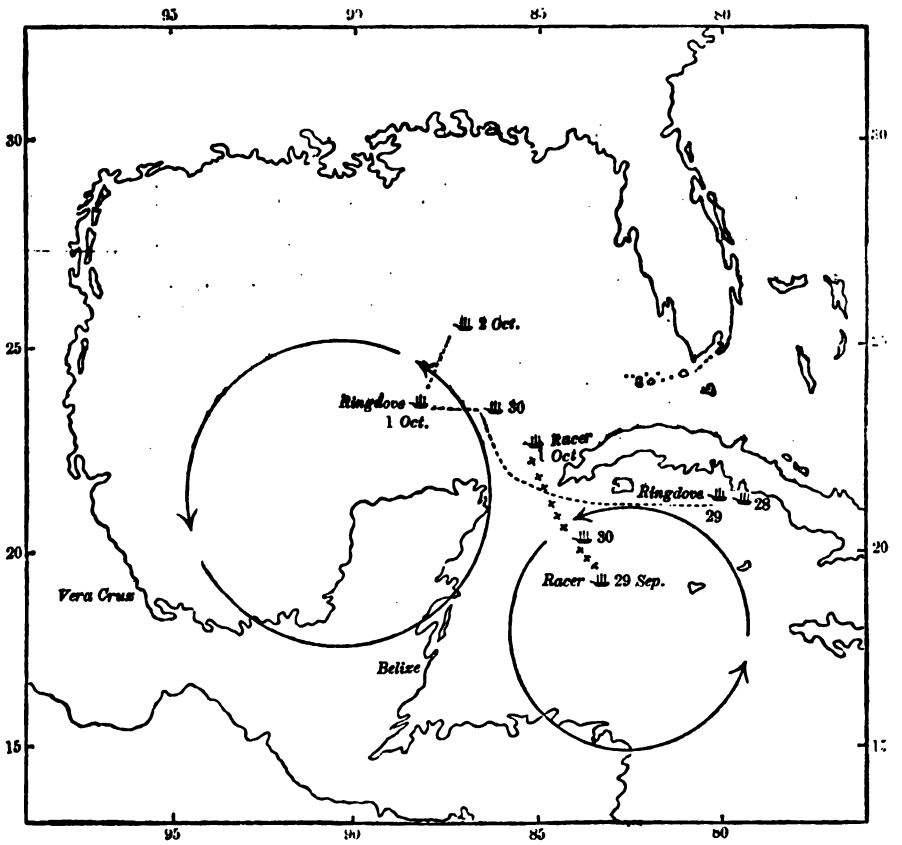
By inspecting the figures it will be seen how the first storm, coming from the eastward, and revolving from right to left, set in at Barbados with the wind at north; whilst the Mauritius Storm, also coming from the eastward, but revolving from left to right, set in nearly at south. In the Barbados Hurricane, the barometer fell with the northerly wind, and in the Mauritius Hurricane with the southerly wind.



The Barbados Hurricane of 1831, *moving W. N.W.*



The Mauritius Hurricane of 1818, *moving W. S.W.*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Vera Cruz
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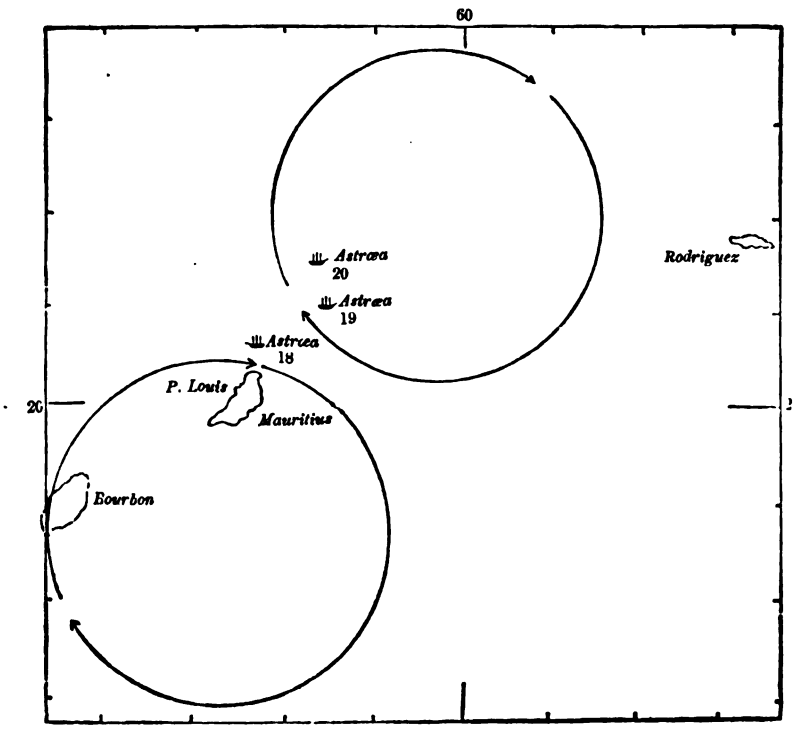
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P. Louis
Mauritius
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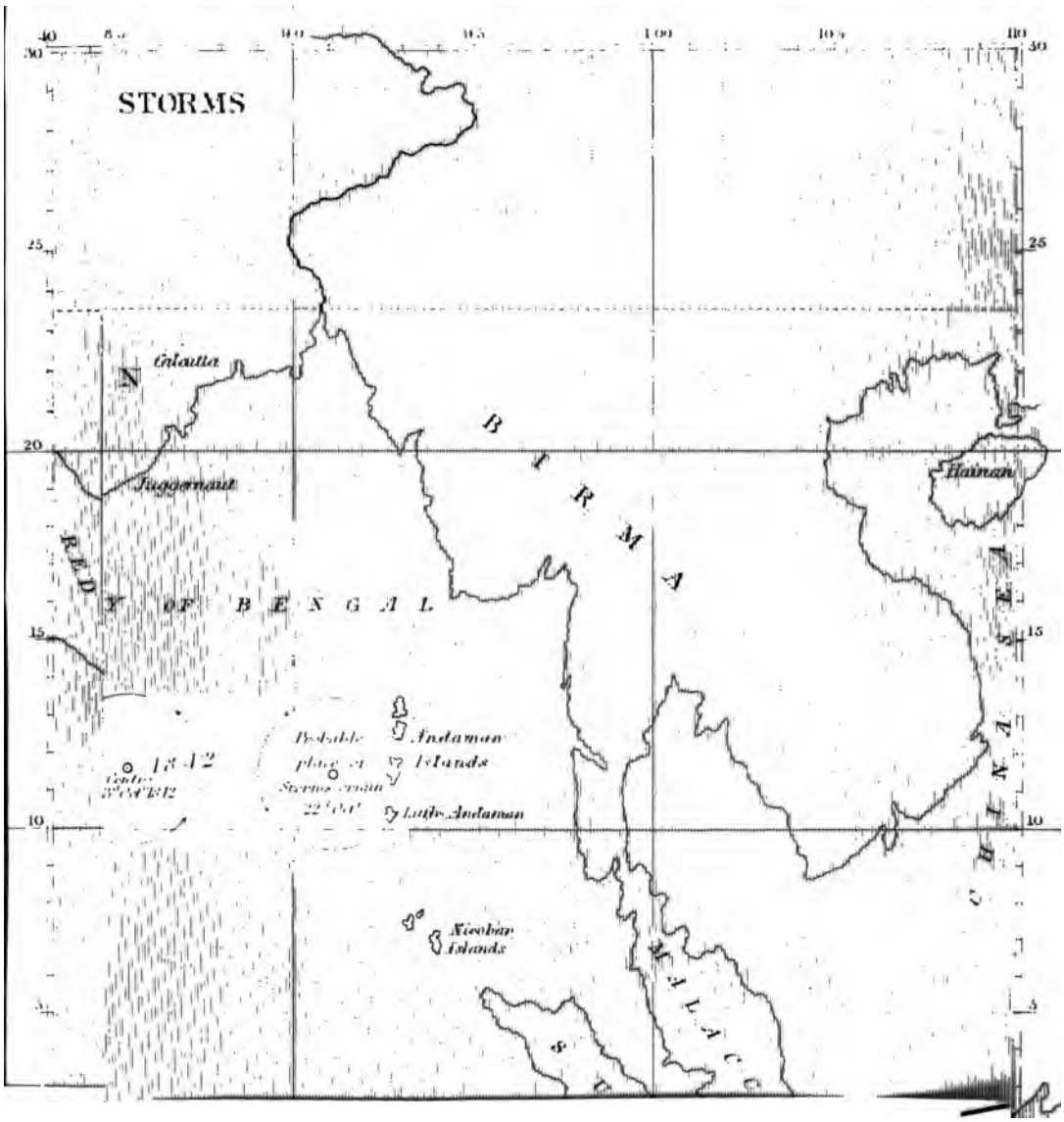

STORMS
Calcutta
Juggernaut
Hainan
BAY OF BENGAL
Andaman Islands
Little Andaman
Nicobar Islands
MALACCA
1842

On the annexed Chart will be found engraved, two Tropical storms, one on each side of the Equator, which exhibit in a more complete manner the counter-movement of storms in the northern and southern hemisphere, since these two hurricanes have been traced over nearly 40 degrees of longitude. That one north of the Equator, was traced by Mr. Piddington, and the other by Mr. Thom, which he calls the Rodriguez Storm. Some description will be given of these storms in a subsequent chapter.

The mode of recording the wind's force, by a scale of numbers, and denoting the state of the weather, by letters of the alphabet, as practised at the Royal Observatory, at Greenwich, and now adopted by the Royal Navy, is found of great use in the study of the winds. This scale of numbers and the symbols denoting the state of the weather will be given below. It is much to be desired that they should be generally used throughout the commercial marine, as well as in observations on shore.

Figures to denote the Force of the Wind.

0 denotes	Calm.		
1 „	Light Air . .	just sufficient to give..	Steerage-way.
2 „	Light Breeze	with which a well-conditioned man-of-war, under all sail, and clean full, would go in smooth water, from	1 to 2 knots.
3 „	Gentle Breeze		3 to 4 knots.
4 „	Moder^e Breeze		5 to 6 knots.
5 „	Fresh Breeze	in which the same ship could just carry close hauled	Royals, &c.
6 „	Strong Breeze		Single-reefs and top-gallant sails.
7 „	ModerateGale		Double-reefs, jib, &c.
8 „	Fresh Gale . .		Triple-reefs, courses, &c.
9 „	Strong Gale. .		Close-reefs & courses.

CHAP. I.

Figures to denote the Force of the Wind.

10	denotes	Whole Gale	with which she could only bear.....	Close-reefed main-topsail and reefed foresail
11	„	Storm. . . .	with which she would be reduced to	Storm-staysails.
12	„	Hurricane .	to which she could show	No canvas.

Letters to denote the State of the Weather.

b	denotes	Blue sky; whether with clear or hazy atmosphere.
c	„	Cloudy — *i. e.* detached opening clouds.
d	„	Drizzling rain.
f	„	Fog—f Thick fog.
g	„	Gloomy dark weather.
h	„	Hail.
l	„	Lightning.
m	„	Misty or hazy—so as to interrupt the view.
o	„	Overcast — *i. e.* the whole sky covered with one impervious cloud.
p	„	Passing showers.
q	„	Squally.
r	„	Rain — *i. e.* continuous rain.
s	„	Snow.
t	„	Thunder.
u	„	Ugly threatening appearance in the weather.
v	„	Visibility of distant objects, whether the sky be cloudy or not.
w	„	Wet dew.
•	„	Under any letter denotes an extraordinary degree.

EXAMPLES.

b c m—Blue sky, with detached opening clouds, but hazy round the horizon.

g v—Gloomy dark weather, but distant objects remarkably visible.

q p d l t—Very hard squalls, and showers of drizzle, accompanied by lightning with very heavy thunder.

The extracts from log-books, and the narratives of ships in gales and storms, which will be found in the subsequent chapters, are printed principally with a view of enabling seamen to study the application of the subject of revolving winds for themselves. By taking such accounts of storms as contain numerous reports from ships at sea and places on land, and laying them down on a chart from the data furnished, the nature of a revolving storm becomes easily understood. The reports relating to the Great Hurricane of 1780, published in "The Attempt to Develop the Law of Storms," furnish a good subject for this purpose.

In the same volume will be found detailed reports descriptive of the six diagrams of storms at page 341.

THE MARINER'S COMPASS.

CHAPTER II.

GREAT OSCILLATIONS OF THE BAROMETER ACCOUNTED FOR BY MR. REDFIELD.

CHAP. II.

Great oscillations of the barometer.

THE discovery that great storms are progressive whirlwinds, led Mr. Redfield to the explanation of what I believe to be the true cause of the fall and rise of the barometer in gales of wind; a solution which, when once it becomes generally received, I think will be of the highest importance to Meteorology. He has explained the cause of those great oscillations of the barometer, which the ablest men have been seeking for since days of Torricelli until now. The truth of Mr. Redfield's explanation is receiving confirmation from all parts of the world, by the observations of seamen.

Oscillations of the barometer explained by Redfield.

His explanation is, that a whirlwind which sets an extended portion of the atmosphere into a state of rapid revolution, diminishes the pressure of the atmosphere over that portion of the Earth's surface, and most of all at the centre of the whirl. The depth of the compressing column of air will at the centre be least, and its weight will be diminished in proportion to the violence of the whirl.

This idea may be exemplified by taking a tumbler half full of water, and after putting the water into rapid revolution, holding it up against a strong light. The surface of the water will be seen to be depressed in the centre of the whirl. The liquid will serve to represent the atmosphere, and if the tumbler be moved

over a fixed point, in the manner in which a progressive whirlwind gale would move over it, it will show how the barometer begins to fall, as the storm sets in; how it continues to fall until the centre has passed, and afterwards rises and resumes its former level.

My own observations attentively made for nearly eight years on the borders of the tropic in the Bermuda Islands, all tend to confirm the truth of this very important explanation. It might be expected that an atmospheric whirlwind embracing several hundred miles in extent, should in some degree heap up the air around it. This effect has been confirmed by barometrical records both on land and at sea.

Great whirlwinds, by lowering the upper atmosphere, bring down portions of the colder regions of the air; and these mingling with the warmer and moister air at the surface of sea, form very dense clouds. In these gyrations it sometimes happens, that the barometer falls as much as two inches, diminishing the atmospheric pressure by $\frac{1}{15}$ part; and it may be expected, as a natural consequence, that very dense clouds should then be formed, such as seamen describe in tempests.

The following is Mr. Redfield's own explanation as published in 1831:

"One of the most important deductions which may be drawn from the facts and explications which are now submitted, is an explanation of the causes which produce the fall of the barometer on the approach of a storm. This effect we ascribe to the centrifugal tendency or action which pertains to all revolving or rotary movements, and which must operate with great

energy and effect upon so extensive a mass of atmosphere as that which constitutes a storm. Let a cylindrical vessel of any considerable magnitude be partially filled with water, and let the rotative motion be communicated to the fluid, by passing a rod repeatedly through its mass, in a circular course. In conducting this experiment, we shall find that the surface of the fluid immediately becomes depressed by the centrifugal action, except on its exterior portions, where owing merely to the resistance which is opposed by the sides of the vessel, it will rise above its natural level, the fluid exhibiting the character of a miniature vortex or whirlpool. Let this experiment be carefully repeated by passing the propelling rod around the exterior of the fluid mass in continued contact with the sides of the vessel: thus producing the whole rotative impulse, by an external force, analagous to that which we suppose to influence the gyration of storms and hurricanes; and we shall still find a corresponding result, beautifully modified, however, by the quiescent properties of the fluid: for, instead of the deep and rapid vortex before exhibited, we shall have a concave depression of the surface of great regularity; and by the aid of a few suspended particles may discover the increased degree of rotation, which becomes gradually imparted to the more central portions of the revolving fluid. The last mentioned result obviates the objection, which at the first view might perhaps be considered as opposed to our main conclusion, grounded on the supposed equability of rotation in both the interior and exterior portions of the revolving body, like that which pertains to the rotation of a wheel, or other solid. It is most obvious, however, that all fluid masses are in their

gyrations subject to a different law, as is exemplified in the foregoing experiment; and this difference or departure from the law of solids, is doubtless greater in aëriform fluids, than in those of a denser character.

"The whole experiment serves to demonstrate that such an active gyration as we have ascribed to storms, and have proved as we deem to appertain to some at least of the more violent class, must necessarily expand and spread out, by its centrifugal action, the stratum of atmosphere subject to its influence, and which must consequently become flattened or depressed by this lateral movement, particularly towards the vortex or centre of the storm, lessening thereby the weight of the incumbent fluid, and producing a consequent fall of the mercury in the barometrical tube. This effect must increase, till the gravity of the circumjacent atmosphere, superadded to that of the storm itself, shall by its counteracting effect have produced an equilibrium in the two forces. Should there be no overlaying current in the higher regions, moving in a direction different from that which contains the storm, the rotative effect may perhaps be extended into the region of perpetual congelation, till the medium becomes too rare to receive its influence. But whatever may be the limit of this gyration, its effect must be to depress the cold stratum of the upper atmosphere, particularly towards the more central portions of the storm; and by thus bringing it in contact with the humid stratum of the surface, to produce a permanent and continuous stratum of clouds, together with a copious supply of rain, or a deposition of congelated vapour, according to the state of the temperature prevailing in the lower region."

CHAP. II.

Why the barometer falls with different winds.

In the northern hemisphere within the tropic, the barometer usually falls with a northerly wind, because whirlwinds come from the eastward. But in the southern hemisphere within the tropic, the barometer usually falls with a southerly wind, because, although whirlwinds there also come from the eastward, they revolve in a contrary direction south of the Equator. In both hemispheres revolving gales blow with a west wind on the side next the Equator. In recurving in both hemispheres, whirlwind storms will have a polar direction for a while. The barometer, during that time, will begin to fall with easterly winds; but after they have recurved, and are moving easterly, the barometer will fall with southerly winds in the northern hemisphere, and with northerly winds in the southern hemisphere.

The above general explanation has exceptions. Ships at sea may sail into whirlwind gales, at any point in their circumference; and they not unfrequently overtake stroms in their course, by sailing faster than these move along.

Nor have gales always an easterly progression in high latitudes. I witnessed one which passed over Bermuda on the 18th August, 1843, moving on a north-north-west progression and towards the Bay of Fundy. That gale would set in over the Bay of Fundy at the or thward of east, and end at the southward of west. Sir James Ross has observed some gales between the Falkland Islands and Cape Horn, beginning south-westerly and ending about north-westerly, also indicative of westerly progression.

Whirlwind gales have a degree of regularity when over the sea, which they lose on coming in contact

with hills and valleys on land, and hence the advantage of studying this subject from the log-books of ships.

Variable climates.

Those constant changes of temperature, to which all extra-tropical climates are subject, are owing chiefly to the gyrations in the atmosphere. In lower latitudes, as at Bermuda, where gales are more regular in their circuits than in high latitudes, the changes from warmth to coolness, and from moisture to dryness, as the winds veer round, and the barometer commences to rise after a fall, are very sensible and striking.

That the variations in the atmospheric pressure, pointed out to us by the great oscillations of the barometer, cause variable currents in the ocean can scarcely now be doubted. This subject has recently received considerable attention, and will be explained in the chapter on the storms of the Bay of Bengal.

CHAPTER III.

ON HEAVING-TO AND ON SAILING FROM A GALE'S CENTRE.

CHAP. III.

When I first entered on the study of the subject of hurricanes, I found that seamen were anxious to have a rule, by which a ship, when laid-to in a hurricane, should come up to the wind instead of falling off from it.

It was explained to me, that in these tempests, when a vessel is lying-to, and the wind veers by the ship's head, she is in danger of getting stern way, even when no sail is set; for in a hurricane, the wind's force upon the masts and yards alone will produce that effect, should the wind veer a-head; and it is supposed that vessels have often foundered from this cause.

When the wind veers aft, as it is called, or by the stern, this danger is avoided; and a ship *comes up* to the wind, instead of *falling off* from it.

Right and left semi-circle of a storm defined.

In order to define the two sides of a storm, that side will be called the right-hand semicircle, which is on the right of a storm's course, as we look in the direction in which it is moving, just as we speak of the right bank of a river. In the two next figures, the central track or courses are shown by spears, and their directions by the spear heads.

When a ship will come up to the wind.

If it be desired to lay a ship to, in a revolving storm, so that she shall *come up* to the wind, instead of *falling*

off from it, the rule will be, when in the *right-hand* semicircle to heave-to upon the *starboard* tack; and when in the *left-hand* semicircle to heave-to upon the *port tack* in both hemispheres.

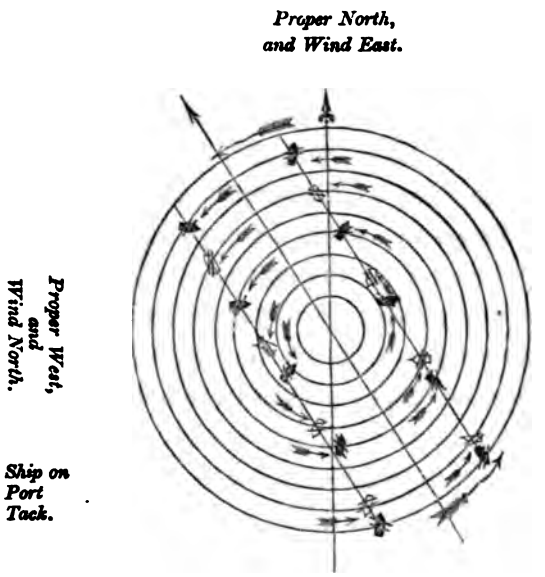

Proper North, and Wind East.
Ship on Starboard Tack.
Proper East, and Wind South.
Proper West, and Wind North.
Ship on Port Tack.
Proper South, and Wind West.

Figure for the northern hemisphere.

The first of two figures inserted here, is intended to represent one of the West Indian hurricanes, moving towards the north-west by north, in the direction of the spear drawn obliquely. The commander of a ship can ascertain what part of a circular storm he is falling into, by observing how the wind begins to veer. Thus, in the first figure, the ship which falls into the right-hand semicircle, would receive the wind at first about east-by-north; but it would soon veer to east, as the storm passes onwards. The ship which falls into the left-hand semicircle, would at first receive the wind at

CHAP. III.

north-east: but with this latter ship, instead of veering towards east, it would veer towards north.

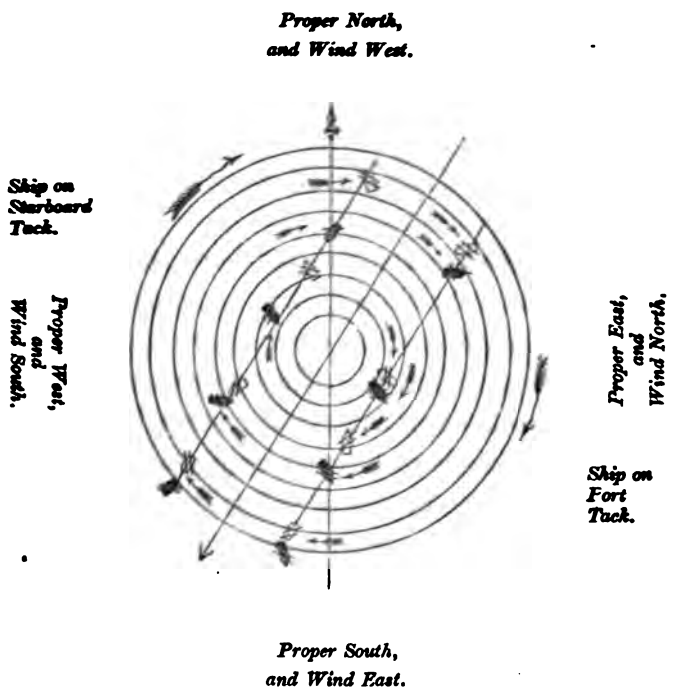
The explanation of the rule will best be made out by attentively inspecting the two figures. In both, the black ships are on the tacks on which the ships will come up to the wind; the white ships on the tacks on which they will fall off.

Black ships come up.

White ships fall off.

The second figure is intended to represent one of those hurricanes in south latitude, which pass near Mauritius, proceeding to the south-westward. The whirlwind is supposed to be moving south-west-by-south, in the direction of the spear-head. It will be seen that the black ships are always coming up, and the white ships always breaking off; and that they are on opposite tacks on opposite sides of the circles.

Figure for the southern hemisphere.


Proper North, and Wind West.
Ship on Starboard Tack.
Proper West, and Wind South.
Proper East, and Wind North.
Ship on Port Tack.
Proper South, and Wind East.

This will be the rule for laying a ship to in a revolving gale when it shall be desired that she shall *come up to the wind*.

From this rule it follows that, if two ships be hove-to within the compass of the same revolving gale and on the same tack, and the one ship comes up whilst the other falls off, the centre of such revolving gale will be passing between them. This will assist in judging approximately of the track gales may be following, even in the case of single ships.

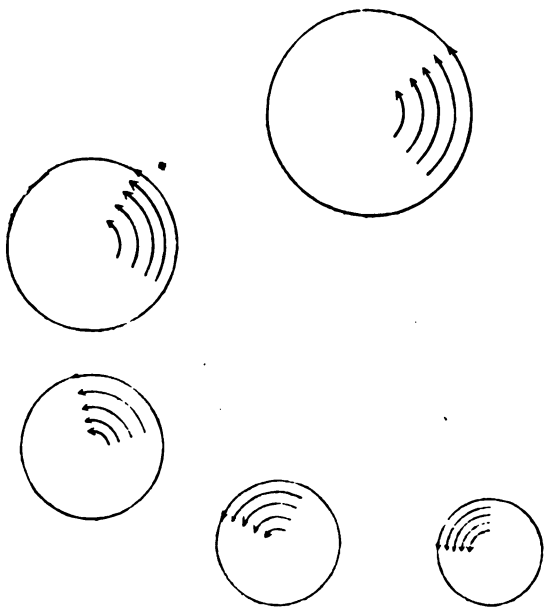
Heave-to on starboard-tack in northern hemisphere; and port-tack in southern hemisphere.

There are, however, reasons for modifying this rule. If we look at the black ships, in the *left*-hand semicircle of the figure of the *northern* hemisphere, and in the *right*-hand semicircle of the figure in the *southern* hemisphere, it will be seen that these black ships point with their heads towards the storm's centre. If they forge a-head, they will draw towards the storm's central track. It may therefore be preferable, as a general rule, when heaving-to in a revolving gale, to bring the ship to the wind on the starboard-tack when on the north side of the Equator, and on the port-tack when on the south side of the Equator. Then will the ships, when shooting a-head, be gradually moving away from the storm's centre.

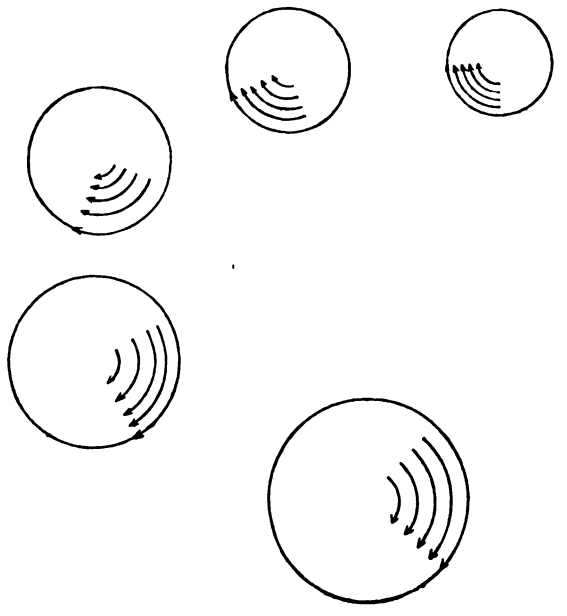
In a progressive storm, there will be one quadrant in which it will be more dangerous for a ship to scud than in the other three, that being the one in which a vessel steered so as to sail before the wind, would be led in advance of the centre of the storm's track. The annexed diagram, in which the quadrants of greatest danger are shaded, will serve to explain, for both hemispheres, what is here meant. Within the Tropics, whilst the course of storms tends towards the west, the

CHAP. III.

Quadrant of greatest danger.



Equator.



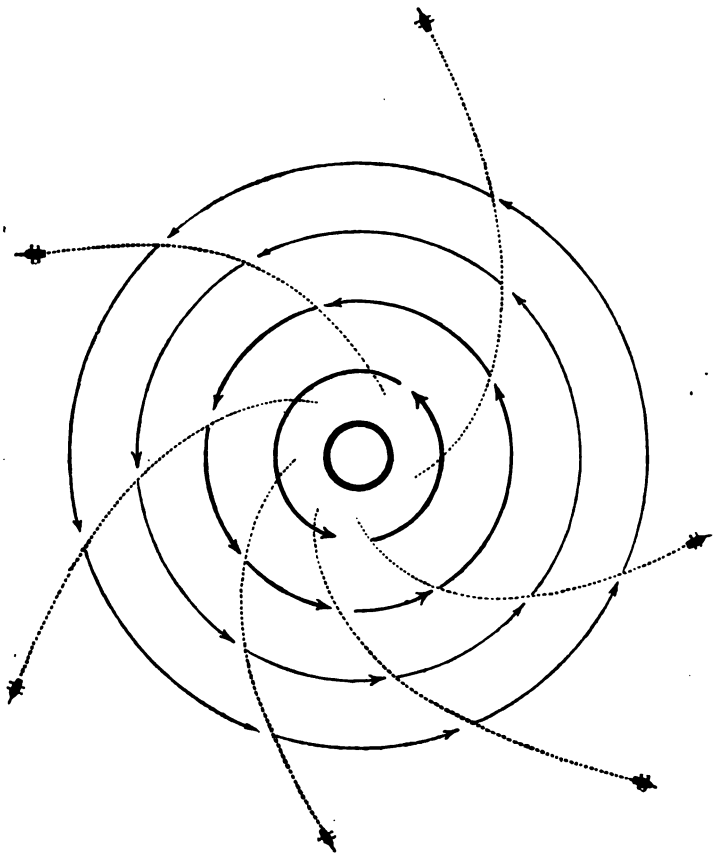
quadrants of greatest danger will be on the west side of the storm. But these quadrants will gradually change their relative positions as the storms recurve, which they generally appear to do in the space from the Tropics to the thirtieth degree of latitude. In high latitudes, where the courses of storms become easterly, these quadrants of greatest danger come to be on the east side of the storm.

Sailing from gale's centre.

Captain Andrews, commander of one of the Royal Mail steamers, pointed out to me, that by keeping the wind on the starboard-quarter when in a revolving storm, in the northern hemisphere, ships gradually sailed from the storm's centre. And by keeping the wind on the port-quarter, when in the southern hemisphere, ships gradually sailed from the centre of a revolving storm.

This rule applies to three quarters of the storm's circle. But care should be taken lest in its application, a ship be carried into what has been called the quadrant of greatest danger, and before the centre of the advancing storm. The practical seaman knows that a ship is difficult to steer during a storm, and in a high sea, with the wind on the quarter. The Racer brig of war upset when steering two points and a half abaft the beam, when under bare poles in a hurricane.

The following figure is intended to show what the track of a ship in the *northern* hemisphere would be, when steered so as to keep the wind on the *starboard* quarter.

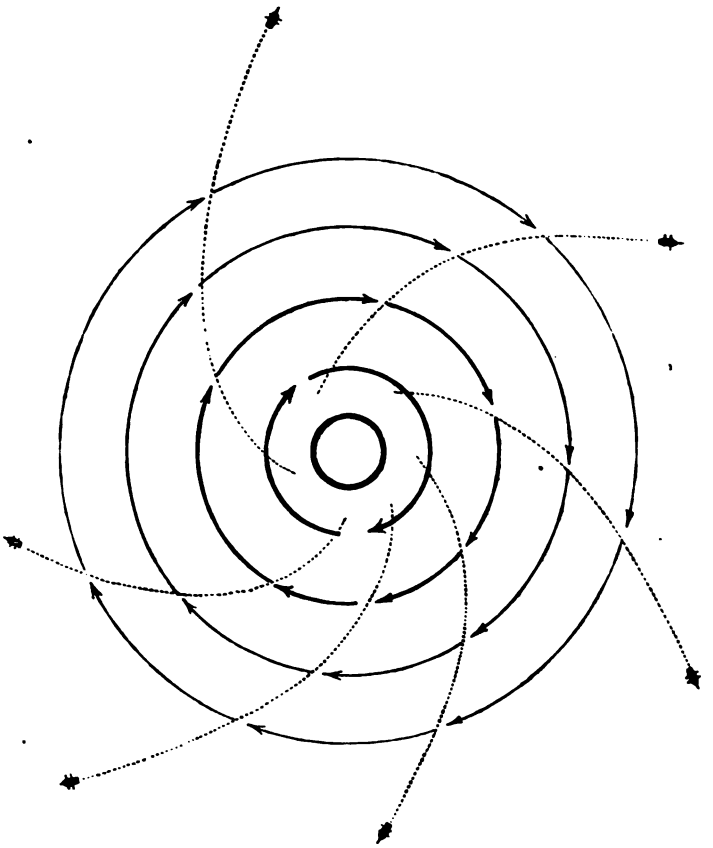


The next figure is intended to show, what the track of a ship in the *southern* hemisphere would be when steered so as to keep the wind on the *port* quarter.

The figures on this and the next page, have been constructed as representing the tracks of ships in whirlwinds supposed to be stationary. Such tracks would of course be modified, in gales having progressive movement.

The best course to be steered, so as to carry a ship away from the centre of a revolving storm, may depend

upon the direction of the waves, as well as of the wind; and which will be considered in the next chapter. CHAP. III.



CHAPTER IV.

ON THE DIRECTION OF THE SWELL RAISED BY STORMS.

CHAP. IV.

THE consideration of the Law of Storms, led me naturally to that of great waves which storms raise; and I shall here attempt to explain how the swell raised by gales of wind rolls on, and how it becomes a cross sea.

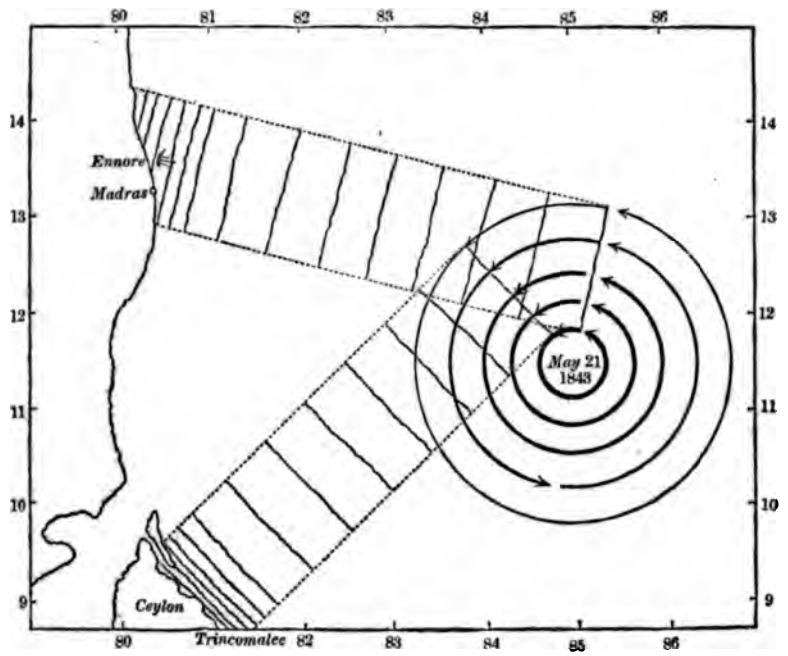
Since storms obey fixed laws, and by their violence raise great undulations of the sea, these undulations probably conform to the same law. We may therefore hope to be able to ascertain, from what part of the whirlwind storm the swell proceeds, which reaches a ship sometimes at a great distance from it; and how the swell changes its direction, with relation to the changes of the wind within the storm's compass.

Whilst sailing on the borders of the tropic in the northern Atlantic, I have frequently watched the gradual change in the direction of the swell, supposed to proceed from distant gales of wind, and it seemed to change in conformity to the usual progressive track of storms. When living in the Bermuda Islands, I was frequently interested by observing the change of direction in the surf which beat against their shores. A coming storm would roll its undulations so as to break upon the south and south-west side of these Atlantic Islands; and as gales proceeded northward, the sea was seen breaking on their northern reefs.

I apprehend that the great undulations raised by

the wind in revolving storms, are raised along the radii of the whirlwind circle, and roll straight onwards in the direction of tangents to the circle of the whirlwind.

I shall suppose, for the sake of illustration, that storms revolve in true circles, and I shall add some figures to explain how waves once propagated may form a cross sea and roll on beyond the storm's circuit.



Swell, northern hemisphere.

On the 21st and 22nd of May, 1843, a strong wind from N.W. and W.N.W. was blowing off shore at Madras and at Ennore, whilst a heavy swell came rolling against the wind from the eastward. The barque Orpheus lay at anchor off Ennore. This swell was no doubt caused by a storm which, coming from

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the south-east at the time, was moving north-west in the direction of Masulipatam. The diagram on the previous page will show in what manner I think the waves, raised by the wind of this progressive whirlwind storm, rolled to the shore at Madras, and to the place where the Orpheus was lying at anchor. An extract from the log book of this vessel will be printed with the account of that storm further on.

The Master Attendant of the dockyard of Trincomalee, in a report of the weather during a hurricane which passed over that place in 1845, says, "There has not been a settled gale of wind at Trincomalee for eleven years, but we have frequently had in the months of November and December, a heavy swell rolling in from the north-east, when there have been gales in the Bay of Bengal."

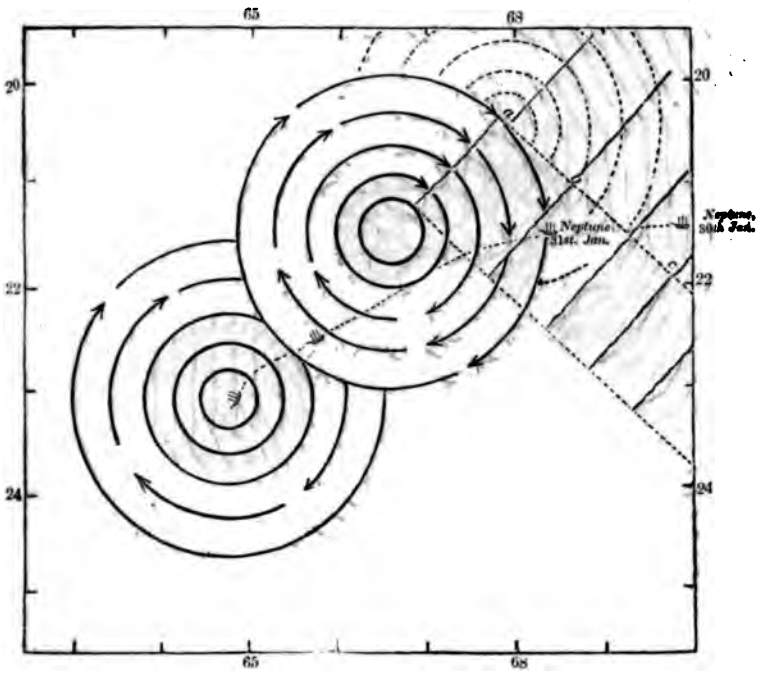
The above figure will serve to show how the swell from the Bay of Bengal gales, rolled to Trincomalee from the north-east.

Swell, southern hemisphere.

The next example is in the southern hemisphere, in which gales revolve in the contrary direction. It is that of the ship Neptune on her voyage from India to England, when she overtook a storm, and sailed into it on its eastern side, on the 31st of January, 1835. On the afternoon of the previous day she experienced a very heavy swell from the north-west. The figure annexed is intended to show how the waves marked *a b c*, proceeding from the dotted circles, would reach the position of the Neptune on the 30th; the dotted circles being the probable position of the whirlwind storm on that day.

In a similar manner waves proceeding from the continuous circles in the figure, would roll undulations

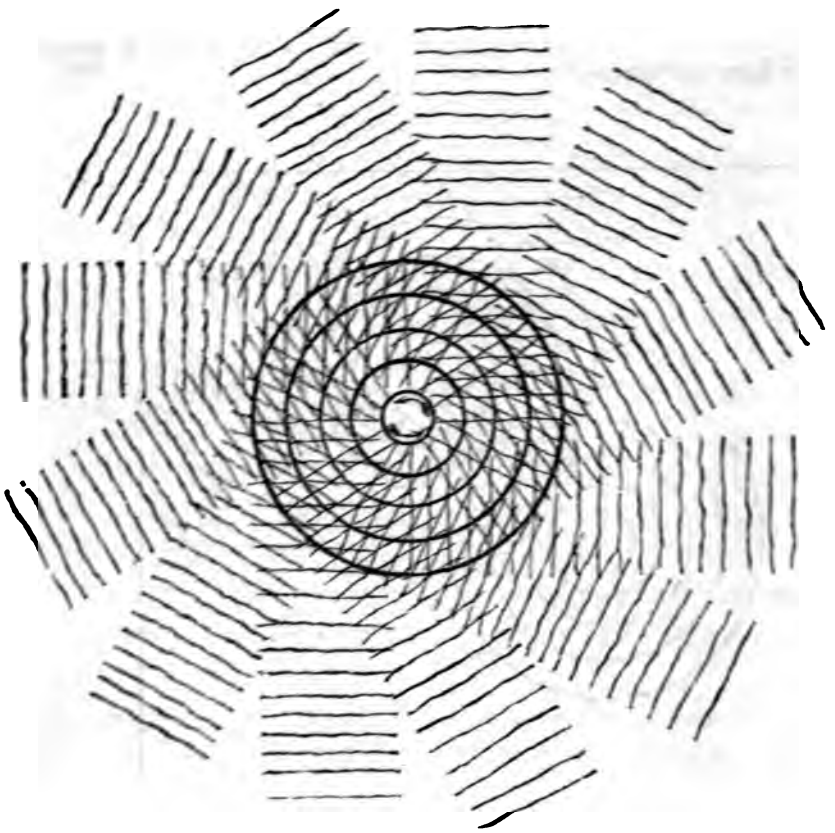
from the north-west to the place of the Neptune on the 31st of January. An extract from this ship's log-book has already been published in the "Attempt to Develop the Law of Storms." CHAP. IV. Page 287, 2nd edition.



Waves would be propagated in all directions within the circuit of the whirlwind; and to some extent beyond it there would be a cross sea. The two next diagrams are intended to illustrate this—one for each hemisphere.

The undulations raised by storms sometimes roll on to a very great distance. The waves propagated by the Barbados Hurricane of 1831, broke against the southern shores of the Bermudas. The swell raised by a revolving winter storm, passing over the Bahama

Cross-Sea and Swell raised by a Storm North of the Equator.



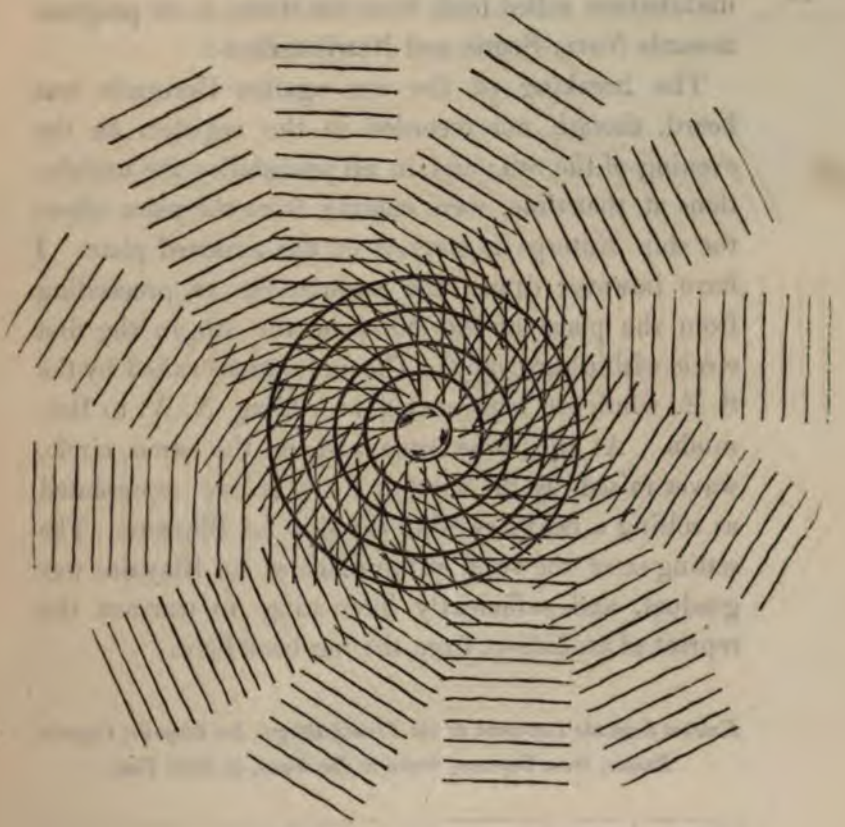
For the Northern Hemisphere.

CHAP. IV.

and Bermuda Islands on the 30th January, 1845, endangered the Eurydice frigate at anchor in the harbour of St. John's at Antigua, although the wind at Antigua was light at the time.

I was in Bermuda when the hurricane of 1839 occurred, and distinctly heard the sea breaking loudly against the south shores on the morning of the 9th September, full three days before the storm reached the islands, as recorded in tables of the state of the

Cross-Sea and Swell raised by a Storm South of the Equator.



For the Southern Hemisphere.

weather, kept at the Central Signal Station. At that time the hurricane was still within the tropic, and distant ten degrees of latitude. As the storm approached the swell increased, breaking against the southern shores with louder roar and great grandeur, until the evening of the 12th September, when the whirlwind storm reaching the Bermudas, set in there. When the storm had passed over the Bermudas, the southern shore became calm, and the northern reefs, in their

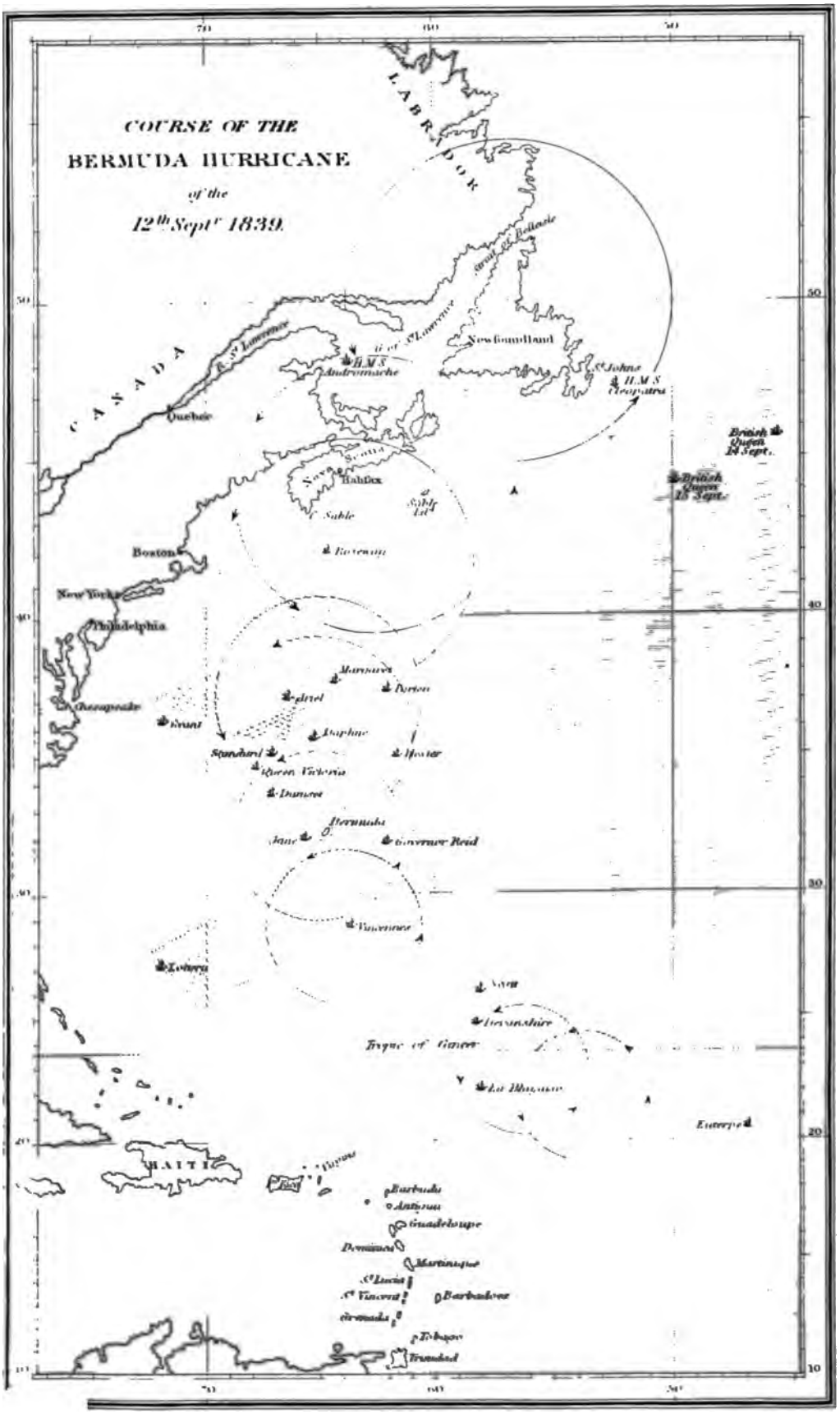
CHAP. IV.

turn, presented a white line of surge, caused by the undulations rolled back from the storm, in its progress towards Novia Scotia and Newfoundland.

The breaking of the sea against Bermuda was heard, though not recorded in the register, on the evening of the 8th; and in all probability the undulations at that time, were coming from the place where the ship Euterpe is marked on the annexed plate. I have however drawn the undulations as proceeding from the place of the storm on the 9th, in the first circle within the tropic. The undulations raised by the S. E. wind are represented as rolling N. W. to Bermuda. At the same time and in the same circle, waves raised by the wind at E. by N. are represented as rolling a heavy swell to the ship La Blayaise. The setting in of the swell at the place of La Blayaise was gradual, and sufficiently interesting to warrant the reprint of an extract from the log-book here.

Extract from the Log-book of the French Barque La Blayaise, Captain Erable, from Cayenne, bound to Bordeaux, in Civil Time.

HOURS.	WIND.	REMARKS.
		September 9, 1839.
A.M. 5	N.N.E.	5 A.M.—Fine weather, nice breeze, *sea rather rough.*
„ 7	„	7 A.M.—Saw a vessel standing E.S.E.
„ 9	„	9 A.M.—Ditto weather, and breeze until
		11 A.M—When wind fell, *sea running very high from eastward.*
P.M. 1	N. N.W.	1 P.M.—Weather rather lowering, *sea running very high still;* ship labouring very much.
„ 5	N.W.	5 P.M.—*Sea very high still;* set topmast studding-sail, took in driver.
„ 9	„	Weather continues lowering, slight showers of rain, *sea very rough;* took in studding-sails and foretopsail.
		September 10.
A.M. 1	„	Ditto weather; took in jib to ease the ship.
„ 5	S.W.	
„ 6	„	Set studding-sails, sea having moderated a little.
„ 7.30	„	Set lower studding-sails.
„ 9	„	Heavy weather; strong breeze; *sea running very high.*


COURSE OF THE
BERMUDA HURRICANE
of the
12th Septr 1839.
LABRADOR
CANADA
Quebec
River St Lawrence
Gulf of St Lawrence
Newfoundland
St Johns
H.M.S. Andromache
H.M.S. Cleopatra
British Queen 14 Sept.
British Queen 15 Sept.
Nova Scotia
Halifax
Sable I.
Sable
Bermuda
Boston
New York
Philadelphia
Chesapeake
Druid
Marmion
Dorion
Pearl
Daphne
Hastings
Standard
Queen Victoria
Dunnose
Bermuda
Jane
Governor Reid
Tartarus
Devonshire
Tropic of Cancer
Entreprenante
HAITI
Barbados
Antigua
Guadeloupe
Dominica
Martinique
St Lucia
St Vincent
Barbadoes
Grenada
Tobago
Trinidad
70
60
50
40
30
20
10

During the 10th the sea continued to run very high, causing the ship to labour very much. On the 11th the sea began to fall a little.

The undulations represented on the plate as rolling to La Blayaise, no doubt rolled onward, and broke against the north-eastern shores of Haiti and Cuba. I think it probable that the heaviest swell proceeding from a storm, may be that which is propelled forward in the track which the storm is itself following: as the undulations, in this case, would be constantly receiving renewed impulses from the storm in its progression. This may account for the unusual degree of grandeur, with which the undulations broke against the southern shores of the Bermuda Islands, just before the storm set in there.

The plate represents undulations rolled back from the storm, when its centre is in latitude thirty-seven, near the place of the Ariel.

It is recorded in the log-book of the Lottery, that she was becalmed, and had the swell from N.E., at the time that the Vincennes was in the vortex of the storm. This swell would no doubt roll on to Nassau and the other Bahama Islands.

The Standard, from Jamaica, bound to Halifax, had the swell at first from N.E., gradually becoming more northerly. This I have endeavoured to show, by drawing lines representing undulations from the place of the storm, when its centre had reached latitude forty-two, and the place of the Roseway.

The log-book of the schooner General Grant, from Baltimore, bound to Bermuda, records on the 14th a heavy swell for twenty-four hours from the north-east.

The British Queen would have a swell at first from

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the S. W., becoming more westerly, and at last N.W., which would create a cross sea; whilst at the same time the shores of Nova Scotia and the United States, would have a high surf beating upon them, by the sea rolling in from the eastward.

The following is an extract from the log-book of the brigantine Standard, T. Blay master, published in the "Law of Storms" (p. 452).

"*Remarks.*—I remark that I have experienced several hurricanes at sea, and have invariably found, that *by observing strict attention to the set of the swell previous to the commencement, and even after, a tolerable correct idea may be formed of the direction the wind is likely to take.*

"I particularly noticed this in the last two which I experienced; and on the 2nd of September, 1838, in a hurricane that commenced at east-north-east, although the sea when I first hove-to set from that quarter, I found it afterwards altered its direction, and came from south-east, and for some time before the wind shifted to that point.

"I felt so confident from that circumstance that I should have the hardest of the storm from that quarter, that I continued to lay-to on the starboard-tack, well knowing that when the wind shifted I should head the sea much better, and consequently the vessel would lay safer.

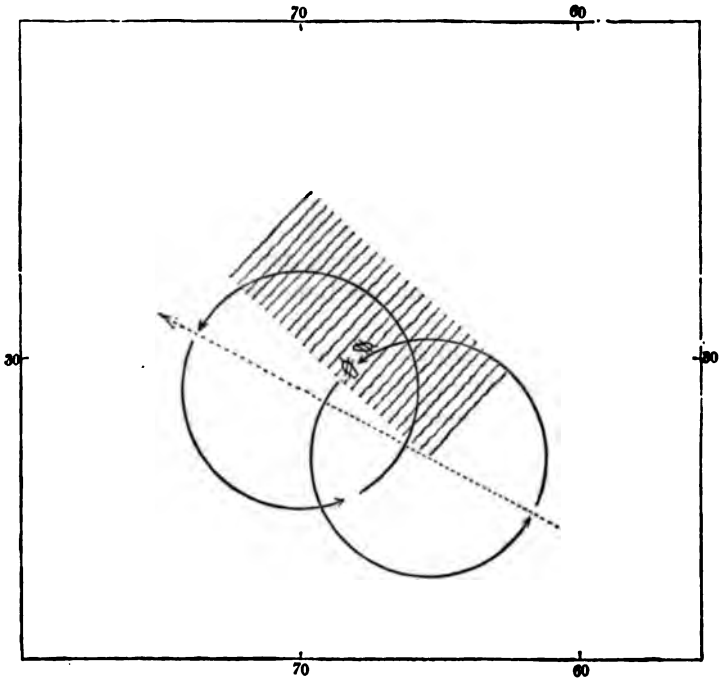
"In the storm of the 12th of September last, although the sky looked much more dismal in the south-east than any other direction, the swell gave no indication of the wind coming from that quarter, as it set constantly from the northward.

"T. W. BLAY."

Having asked Mr. Blay to give me the latitude and longitude of his vessel in the hurricane alluded to, of the 2nd of September, 1838, I received from him the following answer; and I add a figure in explanation. In the case of the Bermuda Hurricane, the Standard was in the *left-hand* side of a progressive gale in the northern hemisphere, and therefore the waves, as well

as the wind from the north-east, became more northerly. But in the instance of the 2nd September, 1838, that vessel was to the southward of the thirtieth degree of

CHAP. IV.



latitude, where progressive hurricanes are frequently found moving in a north-westerly direction; and the Standard seems in this case to have been in the *right-hand* side of a progressive whirlwind, which accounts for the veering of the wind, in the manner described by Mr. Blay.

"Bermuda, February 6, 1849.

"On reference to my journal of that voyage (which fortunately I have in possession), I find the place where I encountered the greatest severity of the storm to be latitude 29°.48′ N., longitude 68°.6′ W., this I feel confident to be correct, for the day after the gale, I ascertained my latitude correctly by a meridian altitude

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of the sun at noon, and in the afternoon got good sights for chronometer.

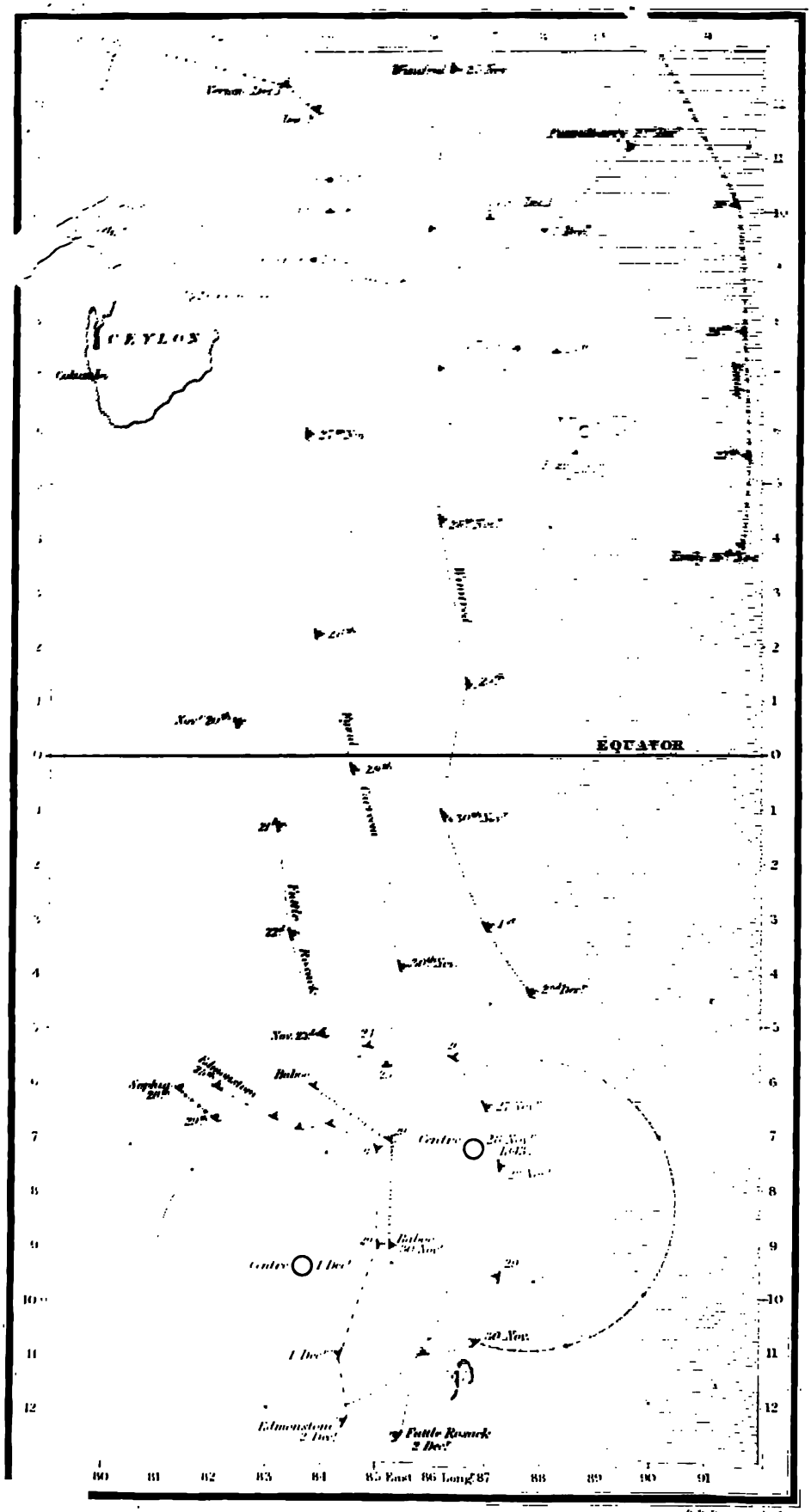
"The gale commenced on the morning of the 2nd of September, at E.N.E., accompanied by a thick hazy sky, continual rain, and heavy swell setting from S.E., and continued to increase gradually. At 4.30 P.M., violent gusts of wind, hard rain, and cross sea; hove-to on starboard-tack, under reefed storm trysail; between the hours of 5 and 6 shipped several seas over the starboard quarter, but I continued to lay-to on that tack, feeling convinced from the direction the sea continued to set from, namely S.E., we should have the hardest of the gale from that quarter (for this phenomenon I particularly noticed had preceded the several hurricanes I had been in previously); therefore it was my safest plan to remain on starboard-tack, for when the wind shifted to that quarter, we should head the sea, which is always an essential point to gain in laying-to in a gale of wind. In these expectations I was not long kept in suspense or doubt, for a few minutes before 6 P.M. the wind suddenly shifted in a hard squall to S.E., and came on with such violence that I expected momentarily to be compelled to relieve the vessel of one of her masts. The gale continued with this violence until 11.30 P.M., at which time it began to moderate and haul more southerly. At 8 A.M., on the 3rd, wind S.W., and fine weather; made all possible sail.

(Signed) "THOS. BLAY.

"To Colonel Wm. Reid."

On the outer circuit of a gale, the change in the direction of the swell, seems to precede the change of wind; but at the centre of a progressive whirlwind, when the rate of progression is rapid, and the shifting of the wind sudden, the wind often changes faster than the swell.

The muddy appearance of the water of the sea, in anchoring depths during violent storms, sometimes precedes the storm, being caused by heavy undulations affecting the bottom of the sea. This effect was remarkable around the Bermuda Islands, in September 1839, a day before the actual arrival of the tempest.



R.E. Davies fculp.

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CHAPTER V.

SIMULTANEOUS STORMS ON OPPOSITE SIDES OF THE EQUATOR.

In the year 1838, I suggested to the Court of Directors of the East India Company, that steps should be taken by them to trace the storm tracks in the Indian Seas. Instructions were accordingly sent to the Governor-General of India, and an invitation issued in consequence, to all officers, civil and military, to send observations relative to storms to Mr. Piddington at Calcutta, who undertook the task of collating them and publishing the results. Owing to the energy and ability of Mr. Piddington, himself a seaman, this suggestion has been attended with results, important beyond my most sanguine expectations. After publishing a large mass of valuable information, on storms in the China and Indian Seas, in separate pamphlets, Mr. Piddington has published a volume, entitled *The Sailor's Horn Book of the Law of Storms in all parts of the World*, a manual which every sea commander should possess.

The two storms on the annexed chart form the subject of Mr. Piddington's Eleventh Memoir, which may be found in the Journal of the Asiatic Society.

These two storms have a peculiar interest, for both were raging at the same time and on the same meridian, within five degrees of the Equator, but on opposite sides of it. They exemplify in a remarkable manner,

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how the wind blows westerly in revolving storms, on their sides which are next to the Equator; for the conjoined action of these two storms, accelerated the west wind on the Equator to a gale.

It shows that revolving winds which reach the Equator, cause there a west wind.

In a valuable article published in the Nautical Magazine for 1843, on the winds and currents of the Pacific Ocean, the writer explains how he was in the habit for twenty years, of sailing to the eastward near the Equator, at a season deemed impracticable before the setting in of the west monsoon; and that on the Equator he frequently found variable winds.

The northern storm.

The northern storm, called the Fazzulbarry's, appears to have arisen about the place where it is marked on the 28th of November, for the ship Emily was sailing north at that time, between the ninety-first and ninety-second degrees of east longitude without crossing it. Her track is on the chart, which faces page 43, and the following is an extract from her log-book, as published by Mr. Piddington:—

Emily.

"*Extract from the Log of the Ship* EMILY, *Captain* ANDERSON, *from Shields to Calcutta, reduced to Civil Time.*

"The following log reached me after the chart was lithographed; it will be seen by it that the Emily was skirting the Fazzulbarry's storm to the eastward on the 27th and 28th, as the Winifred was to the westward. From the heights of the Emily's barometer, we may infer that she had really no part of the vortex, but rather a heavy monsoon setting in; though on the 27th she is near enough to the Fazzulbarry's place to allow us to suppose that both were partaking of the strong easterly stream of wind which prevailed thereabouts on that day.

"The Emily was on the 26th November, 1843, at noon, in Lat. 3°.40′ N., Long. 91°.34′ (to 54′ by Lunars) E., Bar. 30.5,

Ther. 85°, standing to the N. N. E. with variable N. N. W. to N. W., and N. easterly breezes to midnight.

"*27th November.*—Increasing breeze, N.E. b. E. to noon, when Lat. 5°.28, Long. 91°.46′ and 92°.6′, Bar. 30.5, Ther. 83°. P. M. Strong breeze east and sudden squalls. Ship standing 6 and 7 knots to the N. N. W. and N. ½ W. Midnight, the same, and increasing with incessant rain.

"*28th November.*—A. M. Thick cloudy weather, continued rain and heavy squalls. Wind, 2 A. M. E. S. E; at 6 E. Noon, Lat. Obs. 7°.42′ N., Long. 98°.38′ E., Bar. 30.5, Ther. 81°. P. M. Increasing breeze and a high confused sea, wind E. b. N. Midnight, heavy squalls.

"*29th November.*—A. M. Strong gales east, with tremendous squalls and a continuance of heavy rain. 8 A. M. wind N.E. b. E. Noon, Lat. Obs. 10°.17′, Long. 91°.3′, 91°.40′; by 8 P. M. finer; out all reefs. Wind N. E. b. E. and N. E.

"*30th November.*—Increasing again from the N. E. Noon, Lat. 14°.13′ N., Long. 89°.40′ E., Bar. 30.00, Ther. 83°. P. M. Hard gales E. to N. E. with tremendous heavy squalls and a high confused sea. Midnight, wind E. b. N. more moderate.

"*1st December.*—A. M. Variable weather with squalls, wind about E. N. E. Lat. 14°.13′ N., Long. 89°.44′, Bar. 30.10. Ther. 83°. P. M. Squally and torrents of rain. Wind about E.N.E.

"*2nd December.*—Moderate from N. E. Lat. 15°.35′ N., Long. 89°.22′ E."

Fazzulbarry.

The ship Fazzulbarry was sailing northward, about three degrees of longitude to the westward of the Emily, and her track will also be found marked on the chart. This ship had indications of a gale on the 27th. On the 28th the gale appeared to be overtaking her, coming from the south-east, and on the 29th and 30th, she was evidently in the heart of a hurricane.

The Fazzulbarry seems to have been on the outer edge of the gale, on the 1st of December, having the wind S. S. W., at midnight becoming south.

From the 27th the Fazzulbarry experienced a heavy north-east sea; but on the afternoon of the 30th, when

CHAP. V. the ship seems to have kept away to the S. S. E., and had got to the southward of the storm's centre, then, as expressed in the log-book, she met a very heavy westerly sea, rolling up and overpowering the easterly sea; a subject of great interest for seamen to study.

Extract from the log-book of the ship Fazzulbarry, Captain H. Handley, from Bombay, bound to Calcutta, reduced to civil time, and abridged by Mr. Piddington.

"*Abridged Log of the Ship* FAZZULBARRY, *&c.*

"*27th November*, 1843.—At noon moderate breeze from E.S.E. but threatening looking weather to the eastward. Lat. 5°.38′ N., Long. Chr. 88°.40′, Bar. 29.72 and falling, Ther. 82°. For the last two days, current 110 miles to the westward. Remark by Captain Handley, at the beginning of this log. 'Observed many thick white clouds densely packed to the eastward, which I have always found to precede an easterly gale.'

"P. M. Strong breezes easterly (and at 8 P. M. E. N. E.), dark cloudy weather and very threatening appearance to the eastward with heavy N. E. sea on, increasing to a strong gale with dark threatening weather and heavy sea; Bar. 29.65.

"*28th November.*—6 A. M. Wind N. E. Noon, strong gale with dark threatening weather to the N. E. making all preparation for a gale. Lat. 7°.22′ N., Long. Chro. 88.10., Bar. 29.54, Ther. 81.0. P. M. Wind E. N. E. heavy gale with thick dark weather. 3h.30 P. M. saw the 'John Brightman,' steering to the southward. Midnight, gale increasing; Bar. 29.45.

"*29th November.*—A. M. Gale blowing most furiously, saw a ship running to the southward. 10, wind N. E. b. E. marked at noon N. E. Bar. 29.14, Ther. 83°. No observation, Long. 87°.20′. P. M. Furious gale N. N. E. Bar. 29.40. At 11.30, ship in distress, and Arab crew alarmed. Wind at north; bore up at midnight, running S. E., and at 3 A. M. on 30th, S. S. E.

"*30th November.*—Running to the S. S. E. 6½ knots. 3 A. M. gale at the greatest fury 'blowing so hard that it was scarcely possible to hold on;' at 8, a little more moderate; noon, moderating fast, but Barometer running low 29.40, Ther. 82°; Lat.

indifferent Obs. 7°.22′ N., Long 87°.35′ E., having since midnight made 74 miles to the S.S.E. and south. 8 P.M. wind N.N.E., course S.E. 5′ per hour; winds marked as variable N.N.E. to S.W. At 7 P.M. when (from 5 P.M. ship had only been going 1·4 knots) remarks are 'variable dark cloudy weather and a high cross sea; easterly gale broken, but Barometer very low, 29.31. At 7 P.M. 'a heavy westerly sea rolling up and overpowering the easterly sea,' run from noon to 8 P.M. S.E. 32 miles: a brig in sight. At 8 P.M. dark gloomy weather with packed masses of clouds to the S.W., vivid lightning. Vessel steering N.E. 23 miles, from 8 to midnight, when a strong breeze from the S.W. and the S. Westerly sea very high, dark threatening weather, vessel running 8 knots to the N.E.

"1*st December*.—A.M. Increasing gale; at 4 A.M. violent and severe gale S.S.W. if possible worse than before. 7, tremendous S.S.W. gale, Bar. 29.30 to 9 A.M. when Bar. on the rise; at 10 A.M. Bar. 29.45, gale moderating; at 11, Bar. 29.65, strong gales from south; Lat. indifferent Obs. 9°55′ N., Long. 88°.00′ E., Bar. 29.65, Ther. 82. P.M. Wind S.S.W., course N.E. 9½ knots, and run 107 miles; to midnight strong gale; 3 P.M. Bar. 29.75; 10 P.M. 29.80. Wind south, midnight, moderating and sky clearing.

"2*nd December*.—Midnight to noon, N.E. 51½ miles N.E. b. N. 49½ miles. A.M. Wind S.S.E. 6 A.M. S.E. 11 A.M. E.S.E. At noon, fine weather; Lat. 11°17′ N., Long. 89°45′, Bar. 29.90, Ther. 83°.

Winifred. The Winifred, marked on the chart, had the wind on 28th of November at N.N.W. veering to N.W. blowing a strong gale, and was reduced to double-reefed topsails.

Niagara. The ship nearest the Fazzulbarry, on the 1st of December, was the bark Niagara; and the wind with her is stated to have blown a hard gale from S.W. to E.S.E., with a tremendous high sea on. This ship lost sails and sustained other damage. On the 2nd she had strong gales from the eastward. With her the Bar. fell to 29·10.

If the Niagara's storm was from the east south-east,

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it would indicate a progressive motion towards that circle in the chart, which includes the north of Geylon; and I am inclined to think, that this was the course of thé Fazzulbarry's storm.

Imric.

The Imric, on the afternoon of the 30th, was scudding under two close-reefed topsails, with the wind at N. N. E.; and the mercury in the barometer, at about 29·60, was fluctuating in a way the master had never seen before. On the afternoon of the 1st of December, the wind with the Imric veered round to the westward, and continued to do so until 2 A.M. of the 2nd, when it fell nearly calm, the weather looking dismal, with vivid lightning and loud thunder. This seems to have been the centre of the tempest, for the captain states, that they had just time to get all canvas secured as fast as possible, when the gale again burst upon them from S.S.W. The barometer is then marked 29·25. The commander of this ship, Captain Boyd, says, "It is impossible for me to describe the sea that we had to contend with. It had been blowing a gale, and no ordinary one, from N. N. E. round to the S. S. W., for the last three days, and every way we looked, a mountain of water appeared coming towards us. Shortly after noon on the 2nd, the barometer started up to 29·80, but the gale continued without any abatement, until midnight." On the 3rd of December, the gale with the Imric began gradually to abate, the sea to fall, and the barometer at daylight was up at 29·90.

The latitude and longitude for the 2nd of December are not given; but as this ship was scudding before a N. N. E. wind, we may suppose she would be carried into the southern half of the storm. Extracts from

the log-books, both of the Imric and the ship Candahar, as abridged by Mr. Piddington, will be found below. The wind as reported by the Candahar, does not agree with the others. But her reckoning being only by account, she may be placed too far to the north, and this would account for the anomalous report of the wind as given in that ship's log-book.

"*Report from the Barque* MARY IMRIC, *Captain* BOYD, *forwarded by Captain* BIDEN.

"30*th November*, 1843.—Blowing a strong breeze from N.N.E. all possibles ail set; daylight the weather became very cloudy, heavy dark masses rising in the north and passing over with increasing velocity to the southward. Noon, weather dismally dark, with a very suspicious appearance, sun obscured, Lat. by account 12°.20′ north. P.M. The sea rising and the breeze increasing fast, took in all small sails and sent down royal and top-gallant yards, and close-reefed the topsails; indeed at this time I would have been induced to lay the vessel to, the appearance of the weather was so bad, as well as being under the impression that the farther you run into a storm the more likely you are to suffer from its effects, had the Barometer not kept well up; at daylight it stood at 30.03

at noon it rose to 30.11

2 P.M. down to (some error in the original)

where it continued until midnight, at which time it blew a terrific gale with a heavy cross sea, wind steady at N.N.E., and scudding under two close-reefed topsails. I may here add, that I never saw the mercury fluctuate so much, although it never fell lower than 29.60.

1*st December*.—From midnight till daylight the gale continued with unabated force, with frequent hard squalls and heavy rain, and a dreadful sea running, that washed away nearly all the bulwarks, and drowned nearly the whole of the live stock. The sea was uncommonly cross, and *evidently produced from other causes, besides the gale we were then in;* and had we not taken the precaution to get every thing well secured on deck, as well as made secure aloft, the consequences might have been serious. Towards noon the weather cleared away so far as to enable me

Unusually cross sea.

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to measure the sun's altitude, which placed us in 10°.4′ N. Long., 84°.1′ E.; P.M. the gale continued with very unsettled weather, wind veering round to the westward, Bar. 29.60; towards midnight weather tolerably clear overhead, but a dense wild-looking haze all round the horizon, Bar. 29.25.

Clear overhead.

2nd December.—The wind continued to veer to the westward till 2 A.M., when it fell nearly calm, the weather then looking dismal, with continued flashes of vivid lightning and loud peals of thunder; got all the canvass secured as fast as possible, which we had just time to do when the gale burst out from about S.S.W. Fortunately we were prepared for it, and had nothing set but a new small close-reefed maintopsail, which we lay-to under till noon, Bar. stationary at 29.25. It is impossible for me to describe the sea that we had to contend with. It had been blowing a gale (and no ordinary one) from N.N.E. round to S.S.W. for the last three days, and every way we looked a mountain of water appeared coming towards us. Shortly after noon the Barometer started up to 29.80, but the gale continued without any abatement till midnight.

3rd December.—The gale began gradually to abate and the sea to fall; Barometer at daylight up to 29.90.

"*Abridged Log of the Ship* CANDAHAR, *Capt.* W. RIDLEY, *from the Mauritius bound to Calcutta, reduced to Civil Time.*

Candahar.

"*26th November,* 1842.—Wind variable from N.N.E., N. b. E., and N.E. b. N., course north 54° W. 94′, Lat. account 8°.19′ N., Long. 84°.38′ E., heavy squalls, Bar. 29.80.

"*27th November.*—To noon cloudy, wind N.E., strong wind till midnight, when N.E. b. E., Lat. noon 9°.5′ N., Long. 83°.50′. Sunset, heavy squalls, Bar. not marked.

"*28th November.*—Strong monsoon N.E. b. E. 2 A.M., veering to northward. 11 A.M. Violent squall; noon, heavy weather, Lat. account 9°.15′ N., Long. E. 83°.45′, heavy squalls and strong monsoon till midnight, Bar. 29.70.

"*29th November.*—Heavy breeze N. b. E. with squalls; noon, every appearance of a storm, Lat. 9°.26′ N., Lon. 83°.48′ E. 4 P.M. rapidly increasing. At 6 wind north; laid to, heavy squalls and rain, Bar. 29.7.

"30*th November*.—Heavy gales, and tremendous squalls. Wind 1 A.M. N.W. b. N., Lat. 9°.40′ north, Long. 83°.57′ E. 11 A.M. terrific squall of wind and rain, Bar. 29.50. P.M. heavy gale N.W. to midnight.

"1*st December*.—A.M. heavy gale N.W. with terrific squalls. At 2 A.M. wind N. b. E. 8 A.M. N.W. b. W. Noon to 3 P.M. very little wind, Lat 10°.32′ north, Long. 84°.3′ E. At 3 P.M. wind *shifted* to S.W., Bar. fell to 29.40. 5 P.M. shifted again to N.W. 9 P.M. set fore-sail; at 10 wind veered again to S.W.; midnight, gale appearing steady, shook out close reefs, steering north.

"N.B.—From 11 A.M. to midnight steering north 4′ per hour. At 11 and 12, 4½′ per hour.

"2*nd December*.—1 A.M. gale suddenly increased to a most violent storm S.W., hove-to under try-sails; 4 A.M. south; 5 to 6, raging with increased fury, Bar. 29.40. 8 A.M. more moderate, bore up, steering north 6 miles. At 10 wind south. Noon, Lat. account 11°.10′ north, Long. 84°.04′ E. Bar. A.M. 29.60; 2 P.M. steering N.N.W. wind S.S.E. At 4, N.W.b.N. wind S.E. 11 P.M. passed a ship, steering to the S.W. Midnight, Bar. 29.80.

"3*rd December*.—A.M. Strong breeze S.E.; day-light, steady; noon, Lat. Obs. 12°.31′, Long. 84°.7′, fine weather."

Island of Ceylon.

The last report is from Kayts, in Ceylon, giving an account of a storm which passed over the northern part of that island and Paumben, and which appears to have been the same storm encountered by the Fazzulbarry.

Report from KAYTS, *Ceylon, forwarded by Capt.* BIDEN.

"You will no doubt have heard of the gale we have lately experienced down here; and as it was evidently one of the rotatory description.

"It commenced here from the N.W. about noon on the 1st, increasing in violence till 6 P.M. of the 2nd, between which and midnight it blew with great fury, accompanied by a very heavy fall of rain. On the morning of the 3rd it shifted to W.S.W. strong, and by noon moderated at south.

"At Delft Island on the 1st the wind which had been moderate all day at N.W. freshened towards evening from the same quarter, and gradually veered round to between W.N.W. and W.

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by S., at which by 6 A.M. on the 2nd it was blowing a heavy gale. This continued all that day and night till 11.30 A.M. on 3rd, when the wind suddenly chopped round to S. by W. and moderated by daylight; next morning the wind was from S.S.E. and eventually settled at S.E.

Paumben.

"At Paumben.

"1*st* A.M. Wind fresh at N.W.

"P.M. More moderate at N.E.; freshening during the night, but fine.

"2*nd*. A.M. 6. Moderate N.N.W. very cloudy.

"10. Freshening and veering to the westward; Ther. 72°; lower than it has ever been before during the last 4 years; noon, very fresh at N.W. with confused appearance, scud flying fast and low from north; 3 P.M. fresh, W. by S.

"6. Ditto W.S.W. Scud still flying from north, but not so fast; heavy bank of rain to N.E. but without any appearance of wind from that quarter.

"9. Increasing at W.S.W. Midnight, hard gales at W.S.W. with very heavy rain.

"3*rd*. A.M. 6. Sky a perfect lead colour, gale and rain continuing from same quarter, till 3 A.M. when it moderated; and P.M. veered to S.S.W. and south, scud now flying to N.E.

"6. Strong breezes from S.W. to S.S.E. the wind not remaining steady for two consecutive minutes, still thick and hazy with rain.

"4*th* A.M. Fresh, south to S.S.E. and hazy.

(Signed) "J. J. FRANKLIN."

Vernon.

The ship Vernon, from Madras, had the wind from N.N.E., veering to E.N.E., at midnight on the 1st; changing at 2 A.M. on the 2nd, to E.S.E, with confused sea, and much lightning. The barometer falling to 29.54.

By the report kept at the Master Attendant's office, at Madras, there was a high and irregular surf from the 30th of November, increasing on the 1st and 2nd of December, so that neither boats or catamarans could cross it. On the 3rd the wind was N.E. there, with

the barometer 29.89, the weather cloudy and a high surf, which became moderate at 10.30 A.M. next day.

The southern storm.

Mr. Piddington obtained ample proof from the log-books of ships, to show that the storm on the same chart south of the Equator, was a whirlwind storm, moving south-westerly after the 28th of November. Previous to that date its progressive movement is uncertain. A dotted circle on the chart shows the spot where Mr. Piddington thinks that it originated.

In order not to render the figure complex, I have placed upon the chart a portion only of the tracks of ships, the log-books of which have been obtained; and I shall reprint here some of these log-books as abridged by Mr. Piddington, being of value to those persons who may wish to study the subject.

The observations of Captain Rundle, commanding the ship Futtle Rozack, will be found of interest.

"*Abridged Log of the Ship* FUTTLE ROZACK, *Captain* RUNDLE, *from Calcutta to Mauritius, Civil Time.*

Futtle Rozack.

"*On the 20th November*, 1843, the Futtle Rozack, at noon was in Lat. 0°.39′ N., Long. by 2 Chrs. 82°.30′ E., and Bar. 29.93. Winds variable between W.S.W. and S.W. with light fine weather. At 8 P.M. a fresh breeze and squalls, sunset very fiery, Bar. is high. At midnight squalls less frequent, course S. a little easterly.

Swell.

"*21st November.*—1 A.M. to 4, strong breeze, smart squalls, and torrents of rain. Noon, pleasant weather, Lat. Obs. 1°.22′ S., Long. 83°.10′ E., Bar. 6 A.M. 29.93; noon, Bar. 29.93; winds A.M. S.W. to W.N.W. and at times south; P.M. moderate breeze and passing squalls; a *long southerly swell just perceptible;* clouds A.M. spherical cumuli and nimbus; P.M. cumuli and dark nimbi; wind P.M. W. and W.N.W. and N.W. in the squalls; P.M. Bar. 5 P.M. 29.93; at 11 P.M. Bar. 29.03. At 9 P.M. Capt. R. remarks, 'I observed those modifications of lightning more like the Aurora Borealis which I have seen in the North Sea, or rather more like

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the Aurora Australis which I have seen off Van Diemans Land and New Zealand. I have never seen it in low latitudes but as a precursor of strong weather. It gradually lightens up the western horizon with a sudden dark red glare, and thus flickers about for a few seconds and gradually disappears. Bar. is still high. The stars too have a very sickly appearance, and a peculiar dancing motion. I thought at first my eyes deceived me, but my mates observed the same; I suppose occasioned by some dense vapour.'

Lightning.

"22*nd November*.—A.M. Wind marked S.S.W. to W.; course from 3 to 7 knots to the southward; squally, making preparations for bad weather. Noon, Lat. Obs. 3°.18′ S., Long. Chr. 83°.22′ E., Lunars 83°.10′ E. Bar. 1 A.M. 29.93; 6 A.M. 29.93; noon 29.88.

"P.M. Squally, winds W. to W. b. N.; 4 P.M. scud flying swiftly to the southward; 8 P.M. observed many phosphoric flashes in the sea, the luminous space from one flash as large as the cutter; running 6 and 7 knots to S. b. W.; midnight fresh breeze. Bar. 9 P.M. 29.91; at intervals lofty cirri, then again obscured, a nimbus and light scud flying to the south above all.

"23*rd November*.—A.M. to noon, winds W. to S.W. 6 and 7 knots, breeze to noon, when Lat. 5°.22′ S., Long. 83°.53′ E. Bar. A.M. 29.70.; at 8 A.M. 29·50; at 10 P.M. 29.53; noon 29.46.

"Captain R. remarks: 'I find Bar. considerably fallen, with an exceeding long swell from the southward; and at 7 a high N.N.W. sea meeting the southerly swell created an exceedingly turbulent sea. In the squalls the sea has a strange appearance, the two seas dashing their crests against each other shoot up to a surprising height, and being caught by the west wind it is driven in dense foam as high as our tops. The whole horizon has the appearance of ponderous breakers.'

Swell from north and south

"At 8, Bar. still falling. Has there been a gale? Much electricity by the appearance of the clouds; current 59 miles N.E. b. E. ½ E. P.M. Breeze decreasing to 1½ knots, winds west to south, and at times calm. Making preparations for bad weather, appearances being suspicious. Midnight, squally, rain, and calms; dark dismal appearances all round and increasing southerly swell.

"24*th November*.—Dark and gloomy winds variable from S.E. to S.W., noon Lat. 5°.32′ S., Long. 84°.49′ E. Bar. 5 A.M. 29.57; at 9, 29.63; at noon, 29.64.

"Capt. R. remarks, 'I do not like this gloomy weather; with

wind lulling and then coming on again with a warning noise, there either has been or will be bad weather.' At 4 calm; at 5 severe squalls from S.S.W., tremendous high sea from the southward, ship rolling dreadfully at intervals. Bar. at 4 P.M. 29·63; at 8 P.M. 29.63; clouds marked as very low.

"25*th November*.—A.M. Wind south veering to the S.W. 'and vice versa,' strong gusts from S. to S.W. with a high cross sea. occasioned by a short northerly sea meeting the long south swell, Noon, strong gale at intervals, but decreases as the wind hauls to S.W. increasing to southward; ship under close reefed main-top-sail and fore-sail; Lat. 5°.42′ S., Long. 85°.3′ E., standing to the E.S.E. Bar. at 6 A.M. 29.64; noon 29.63.

"P.M. Strong gales S.W. b. S. mostly from S.W. attended with violent squalls. The rain water exceedingly cold, the sea water very warm, much more so than usually. P.M. Mountainous sea from the southward. Lofty scud above the lower strata of clouds flying quickly *to the southward* at 7, breaks in the clouds, stars visible, but very dull. Bar. at 10, 29.61. Midnight, wind in severe gusts succeeded by lulls of a few minutes' duration. Clouds, low stratus not perhaps at 100 yards' height, flying before the wind, breaks at times in the clouds, stars visible, with lofty scud flying with inconceivable rapidity *to the southward.*

Rain cold.

Stars visible.

"26*th November*.—A.M. Laid-to under close reefed main-top-sail. Wind S. to S.W., squalls with rain, exceeding turbulent sea; noon Lat. 5°.30′ S., Long. 86°.23′ E.; Bar. 6 A.M. 29.62; at noon 29.63. P.M. Fresh gale with furious squalls and rain as cold as ice. Edging away to E.S.E. and S.E. b. E. under two close-reefed topsails, wind S.W. and at intervals W.S.W. and W. At 8, ropes and gear on deck brilliantly spangled by small luminous sparks from the sea which when examined appeared to be fragments of Medusæ. Again visible to the W.S. westward the sullen red glare and flickering lightning; midnight, squally, sea presenting flashes of phosphoric light in all directions; Bar. at 9 P.M. 29.63, clouds low stratus and ponderous nimbi.

Rain cold.

On starboard tack.

"27*th November*.—A.M. Increasing gale west; and at 2 N.W. to noon; very high sea; at 1, wind *shifted* from W.S.W. to N.W. creating a tremendous sea; 10 A.M. struck by a heavy sea which laid the ship on her beam ends, lost main-top-mast; scudded before the wind to the S.E. under bare poles. A.M. Bar. falling rapidly; noon Lat. by D.R. 6.°38′ S., Long. 86°.53′ E.; Bar. 5½ A.M. 29.63; at 10h. 29.53; at 11h. 29.47; at 11½h.

Scudding.

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29.44; at noon, 29.43, and Ther. 80°; clouds throughout exceeding low stratus.

"P.M. Wind N.W. to 10 P.M. when north; course S.E. to 10, and then south; 3 feet water in the hold, and most of the crew sick; vessel making only 4 knots per hour before the wind and labouring excessively. At 6, Bar. rising very fast; and at midnight falling again, with dark gloomy threatening weather all round. Bar. at 2 P.M. 29.46; at 4h. 29.47; at 5h. 29.56; at 6h. 29.62; at 7h. 29.63; at 9h. 29.61; at 9½h. 29.58; at 10½h. 29.62; at 11h. 29.50; at midnight 29.49.

"*28th November.*—Wind N.E. the whole 24h. A.M. increasing gale, wind *veering suddenly* to N.E. in a furious squall; lost fore-top-mast, ship lying-to in much distress; Bar. 29.47 at 1 A.M.; 2 A.M. 29.45; at 5 A.M. 29.44; at 6h. 29.43; at 11h. 29.45; noon 29.49. Lat. D.R. 7°.39′ S., double Alt. 7°.47′, Long. 87°.17′ E.

Very confused sea.

"P.M. Wind N.E. tremendous squalls blowing with inconceivable fury; the sea rising in huge pyramids yet having no velocity, but rising and falling like a boiling cauldron. I have never seen the like before. I was in the height of the terrible hurricane of September 1834, in the West Indies; I have been in a typhoon in the China Sea; in gales off Cape Horn, the Cape of Good Hope, and New Holland, but never saw such a confused and strange sea: I have seen much higher seas, and I am sure wind *heavier*, but then the sea was regular and the wind steadier.

"10 P.M. Dreadful squalls and a confused sea; both cutters washed away and mizen-topmast carried away; blowing still harder, but Bar. rising; midnight, tried to set the foresail and scud, but it was blown to pieces. Bar. 2 P.M. 29.49; at 5h. 29.5; at 10h. 29.53; at 11h. 29.54; at midnight 29.56.

"*29th November.*—A.M. Wind N.E. till noon, still blowing fearfully at times. Again tried to scud and ran S. by W. 58 miles to noon, Bar. steadily rising. 10 A.M. good sight for Chr. 9 A.M. Bar. 29.57; at 7h. 29.57; at 10h. 29.58; at noon 29.59; Lat. 9°.47′ S., Long. 87°.18′.

"Noon, blowing with inconceivable fury at times, with the sea I think more agitated and confused than ever; rising up in monstrous heaps and falling down again without running in any direction. Noon, laid-to again.

"P.M. Violent squalls and tremendous high sea, 3 feet water in the hold, wind N.E. to E. Midnight, more moderate at times. Bar. 2 P.M. 29.60. Clouds during this 24h are exceeding low,

stratus scudding in all directions, upper strata to the southward, lower to the west; at other times apparently to north and east.

"30*th November*.—A.M. Gale abates a little, high sea, ship lying-to with tarpaulins in the mizen rigging, wind marked N.E. to E.; Bar. noon 29.61; Lat. Obs. 10°.48′ S., Long. 86°.46′ E.

"P.M. Moderate gale at times, but the sea does not go down; wind N.E. throughout. Bar. 1 P.M. 29.61.

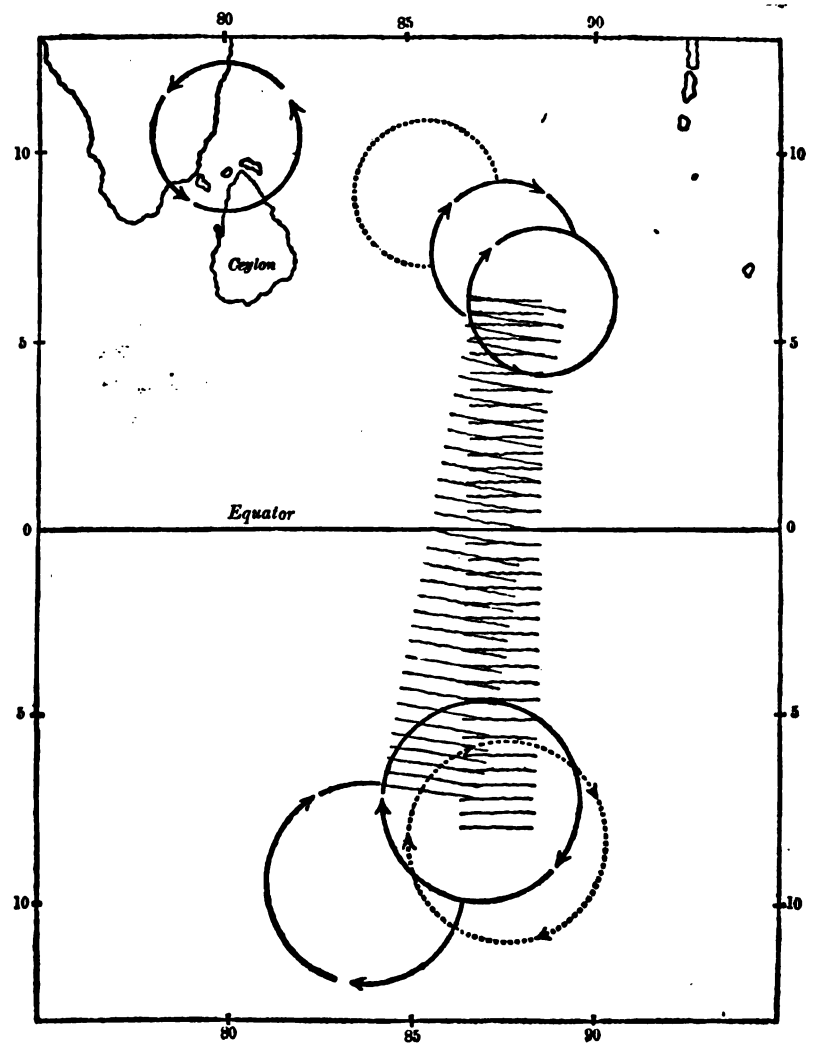
"1*st December*.—A.M. Gale and sea moderating. Winds N.E. to noon, when Lat. 11°.10′S., Long. 85°.47′E.; Bar. 6 A.M. 29.61, noon, 29.62. P.M. Squalls of rain at intervals, wind N.E. to midnight. 6 P.M. Bar. 29.63; midnight, 29.64.

"2*nd December*.—Moderate and passing squalls, sea much gone down, repairing damages; winds east to noon, when Lat. 12°.30′, Long. Chro. 85°.34.

"3*rd December*.—At noon quite fine.

The sea, as described by Captain Rundle on the afternoon of the 28th, may have been caused by the progressive motion of the whirlwind storm he was in alone. But the effect of that storm upon the sea may have been augmented by the swell rolling from the other storm, north of the Equator, for the distance was only ten degrees. The swell which endangered the Eurydice frigate in 1845, in the harbour of St. John's, Antigua, and which came from the neighbourhood of Bermuda, travelled through fifteen degrees of latitude; and the undulations of the Barbados Hurricane of 1831, which broke against the shores of Bermuda, must have rolled through nearly twenty degrees. The undulations caused by the two storms north and south of the Equator, may have reached each other in the manner the following diagram is intended to represent.

The next abridged log, that of the Fyzul Carreem, is interesting, as showing that when that ship was crossing the Equator, and midway between the two storms, on the 29th of November, she had "a fresh gale



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at west, with heavy squalls, increasing to a strong gale and sea." As the ship sailed on, and approached the southern storm, it is noted that she had "a strong sea" from W.S.W.; and on the 2nd of December, when she was behind the storm, and steering S.W. by S., she had a head sea.

"*Abridged Log of the Ship* FYZUL CURREEM, *Capt.* J. BALLANTINE, *from Calcutta towards the Mauritius, reduced to Civil Time.*

Fyzul Curreem.

"*26th November,* 1843.—Noon, fine breeze N. and cloudy, Lat. 7°.50′ N., Long. 83°.52′ E., course south, 7 knots per hour; P.M. and to midnight squally; wind steady at N. and N. by E.

"*27th November.*—A.M. to 9, wind about north; 10 to noon, N.N.W. squally; noon, Lat. 5°.11′ N., Long 83°.31′ E.; 9 P.M. heavy squalls, wind and rain from N.N.W. to midnight.

"*28th November.*—A.M. to noon, fresh breeze, &c., tolerably clear; wind varying N.N.W. to N.W. by N.; 8.30 A.M. an English barque standing to the northward and eastward; noon Lat. 2°.6′ N., Long. 83°.40½′ E.; by 8 P.M. increasing to fresh gale W. by S.; to midnight course south, 8 knots throughout.

West gale on Equator.

"*29th November.*—A.M. fresh gale west, increasing with heavy squalls to a strong gale and sea by noon, when Lat. 00°.54′ S., Long. 84°.30¼′ E.; current of about 24 miles to the eastward. P.M. gale continuing and increasing at times, to midnight, wind strong at west, and course south, 7 and 8 per hour.

"*30th November.*—8 A.M. more moderate; noon, fresh gales; wind steady at west throughout; Lat. account 3°.50′ S., Long. 85°.27′ E.; current of 21 to the eastward; P.M. more moderate and clear, wind west; and at 7 P.M. W. ½ S.; midnight moderate and clear; a strong sea from the W.S.W.

"*1st December.*—A.M. a little squally; by 10 A.M. wind at N.N.W., light 3 knot breeze; noon, fine; Lat. 5°.39′ S., Long. 85°.37¼′ E.; current and sea estimated by Captain Ballantine at 29′ to the N.N.E.; a strong sea from the W.S.W.; P.M. winds N.N.W., and at 9 N.W., and fine to midnight.

2nd December.—A.M. to noon, light N.N.E. winds with a heavy *head* sea. (Ship steering S.W. by S.) Lat. 6°.41′ S., Long. 85°.00¾′ E.; no current, but the sea has retarded the ship's progress 10 miles.

The tabular memorandum of the weather experienced by the Winifred, shows that she also had the gale from the west when she crossed the Equator.

Tabular Memorandum of the state of the Weather, as observed during a Passage from Calcutta towards the Mauritius.

By CAPTAIN WEBB, *Ship* WINIFRED.

Date in Nautical Time.	Hour.	Latitude and Longitude at Noon.	Height of Bar.	Therm. Air,	Therm. Water.	Explanatory and General Remarks.	
1843.							
Nov. 24th	Noon	15° 27′ N. 87° 10′ E.	29 83	78	79	N.E. steady	Fine clear weather and smooth water.
	8 P.M.	.. ..	.. 83				
	4 A.M.	.. ..	.. 83				
Nov. 25th	Noon	12 43 N. 86 23 E.	29 82	78½	78	N.E.	Fresh breezes and cloudy weather.
	8 P.M.	.. ..	.. 81	..	..	N.N.E. } Strong threatening clouds and gloomy appearance.	
	4 A.M.	.. ..	.. 81	..	..	Variable to }	
Nov. 26th	Noon	9 40 N. 85 48 E.	.. 80	78	78	East.	From 4 A.M. to noon. Dark, gloomy, and wild appearance.
	8 P.M	.. ..	.. 76	..	..	N.N.E. squally	A 9 P.M. strong squalls and heavy rain, took in and made sail accordingly; passed the ship Hooghly, of London.
	4 A.M.	.. ..	.. 72	..	..	East, and variable and squally .	
Nov. 27th	Noon	7 4 N. 85 56 E.	.. 67	78	78½	E.N.E. strong squalls .. .. [heavy rain.	Sudden dangerous gusts and violent squalls, with very little warning from their first appearance above the horizon; heavy rain attending the squalls.
	8 P.M.	.. ..	.. 67	..	..	North, and thick gloomy weather;	
	4 A.M.	.. ..	.. 58	..	..	N. N.W.	
Nov. 28th	Noon	4 27 N. 85 58 E.	.. 65	79	78½	N.W. throughout	Strong gales, short confused sea, ship labouring much; at 11 P.M. most terrific squalls, accompanied with torrents of rain; dark, dismal weather; reduced sail to double-reef topsail.
	8 P.M.	.. ..	.. 60	..	..	N.N.W. continued throughout of heavy rain the 24 hours, and gloomy weather.	
	4 A.M.	.. ..	29 57				
Nov. 29th	Noon	1 20 N. 86 30 E.	.. 59	81	81	....	Succession of dangerous squalls and thick weather.
	8 P.M.	.. ..	.. 66	..	..	N.N.W. } Violent squalls, varying to dark, gloomy, dismal weather.	Observed the most severe squalls these last three days to commence with drizzling small rain, after which (generally) follows torrents of rain, accompanied with most violent and terrific squalls. A ship must be well prepared to meet them, to save the canvass and spars from destruction; Barometer rising and falling during the squalls and rain, so that no dependence could be placed upon it, varying at times in an hour from 29.74, to 29.57, &c.
	4 A.M.	.. ..	.. 65				
Nov. 30th	Noon	1 1 S 86 0 E.	.. 64	83	83½	W. and	
	8 P.M.	.. ..	.. 68	..	..	West } Violent varying squalls as before stated, moderating.	
	4 A.M.	.. ..	.. 74				
Dec. 1st	Noon	3 15 S. 86 56 E.	.. 67	82	82½	N.W.	
	8 P.M.	.. ..	.. 68	..	..	N.W.	
	4 A.M.	.. ..	.. 68	..	..	Calm and promising.	
Dec. 2nd	Noon	4 21 S. 87 34 E.	.. 74	83	83	Calm weather.	

"*Abridged Log of the Ship* EDMONSTONE, *Captain* M'DOUGAL, *from Calcutta, bound to Mauritius, reduced to Civil Time.*

Edmonstone.

"*25th November.*—At noon in Lat. 6°.15′ S., Long. 82°.30′ E. P.M. Winds variable from the S.W. to S.S.E.; to midnight, light breezes and cloudy.

"*26th November.*—Steady light breeze to noon from S. S.W., no observation. Lat. account 6°.42′ S. Long. account 83°.06′ E. P.M. to midnight, winds S. S.W. to S., brisk breeze.

"*27th November.*—A.M. Strong breeze about south, with hard squalls and turbulent sea. Lat. Obs. 6°.58′ S., Long. 13°.36′ E. P.M. variable strong breezes from the southward with hard squalls. Midnight, 'strong gale.'

"*28th November.*—A.M. Strong gale and mountainous sea. Wind about S. S.W. Noon, Lat obs. 6°.50′ S., Long. 84°.04′ E. P.M. wind S.W.; gale increasing to midnight.

"*29th November.*—2 A.M. wind W. S.W., severe gale; 9 A.M. hove-to under reefed trysail, wind west, no observation. Lat. account 7°.12′ S., Long. 85°.02′ E. P.M. 'violent gale W. by S.,' heavy cross sea. 8 P.M. wind hauled to W. N.W. and moderated; Bar. rising. 10 P.M. W. N.W., made sail and stood to the S.S.E. 9′ till midnight.

"*30th November.*—3 A.M. Wind N.W.; at 6, N. N.W.; daylight, gale increasing, and Bar. falling; to noon, severe gale N. N.W. with furious gusts. Lat. account 9°.3′ S., Long. account 85°.4′ E. 9 P.M. wind N. N.W., severe gale and high cross sea; at 8, wind N. by E. to midnight, when Bar. rising a little.

"*1st December.*—By 9 A.M. strong gales N.N.E. to noon. Lat. by account 11°.15′ S., Long. account 84°.22′ E. P.M. the same, wind N.E. to midnight; carried away chainplates and hove-to; midnight, more moderate.

"*2nd December.*—A.M. Moderating to noon; wind N.E. to 9 A.M., and north to noon, when Lat. 12°.23′ S., Long. 84°.30′ E. P.M. wind N.E., moderate breeze and heavy cross sea.

"*3rd December.*—Noon, Lat. 13°.51′ S., heavy sea still continuing, wind E.N.E. and fine.

"*Note by Mr. Piddington.*—Captain M'Dougal informs me, that during the storm, his Bar. was at 29.38, and the Symp. at 29°.28′ the lowest, the Ther. steady at 72° throughout the gale.

"The latitude and longitude given are partly from the chart, and partly from account worked either forward or backward to the nearest day of observation. Captain M'Dougal observes, that

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having emigrant 220 coolies on board, he was obliged, during the height of the storm, to steer various courses to obtain for them as much comfort and safety as the weather would allow of, so that he can only give me limits *within* which he thinks the vessel's position must have been.

"The log gives as nearly as can be ascertained a current of 149 miles to the south and 116 miles to the west; but it is necessarily very imperfect, and the set of the storm wave and current on one day was doubtless counteracted, in some degree, by that on a different part of the storm circle on another."

"*Abridged Log of the the Barque* BABOO, *Captain* STUART, *from Madras to the Mauritius, reduced to Civil Time.*

Baboo.

"26*th November*, 1843.—At noon, Lat.6°.17′ S., Long. about 83°.40′ E., wind S.W. by S., ship steering to the S.E. by S., 4½ knots, squally and rain. Spoke the Tartar 7 days from Ceylon. Midnight, wind S. S.W.

"27*th November*.—A.M. to noon. Strong breeze and cloudy; no Obs. P.M. Fresh gale S. S.W.; 6 P.M. south, course E.S.E. Midnight, heavy squalls and rain.

Starboard tack.

"28*th November*.—A.M. Heavy squalls and rain continuing, wind from S. to S.W., course S.E. to S.S.E. Noon, Lat. 7°.8′ S., Long. 85°.10′ E., heavy gales S.W. by W., and sea. P.M. wind W. S.W.; at 6 and to midnight, when strong gales and rain; course marked as S. by E. to S. by W. In the newspaper report Captain Stuart states this to be the day on which the wind became very tempestuous.

"29*th November*.—A.M. Strong gales continuing W.S.W. and at 6 A.M. this day, course S.S.W. Noon, heavy gales throughout. P.M. increasing, wind marked N.W. Course S.W., and at midnight S. b. W.

"30*th November*.—Daylight, heavy squalls and rain N.W. Course S.W., 7 knots. Noon, Lat. 9°.2′ S., Long. 85°.9′ E.; strong gale. P.M. wind N.W. Midnight, heavy squalls and rain.

"1*st December*.—Wind N.W. to noon; course S.W. b. S. and S.W., Lat. 11°.0′ S. P.M. Heavy gale N.N.W. Course, 7½ knots to S.W., and at 6 P.M. to W.S.W. Heavy gale and rain; midnight, increasing.

"2*nd December*.—Wind and weather as before, course W.S.W. 7½′; noon, no observation. P.M. wind marked easterly, course W. b. S.; heavy gale and squalls to midnight.

"*3rd December.*—Wind easterly, course W. b. S. 7½ knots. Noon, heavy gale, no observation. P.M. wind easterly, course W.S.W.; 6 P.M. wind N.E. Hove-to at 8 P.M.

"*4th December.*—Mizen top-mast went, lost main-yard and sprung mainmast, ship labouring *as if in broken water on a reef.* No observation. P.M. fresh gale *and fine,* wind E.N.E. lying-to; midnight, moderate and fine.

"*5th December.*—6 A.M. bore up to the W. by S. Wind easterly; noon, Lat. Obs. 18°.6′ S. Fine weather."

"*Abridged Log of the Ship* SOPHIA, *Capt.* ANDREW, *from Bombay towards the Mauritius, Civil Time*

"*On the 22nd November.*—At noon the Sophia was in Lat. 4°. 53′. S., Long. 79°.54′ E., standing till midnight to the S.S.E. with a moderate breeze from the S. westward, squally weather. Sophia.

"*23rd November.*—Threatening dark weather and puffy, to noon, when Lat. 5°.54′ S., Long. 80°.30′ E. P.M. to midnight, strong breeze and cloudy; ship standing to the E.S.E. and E., wind S.S. westerly, throughout heavy head swell; midnight, more moderate.

"*24th November.*—At 4.30 A.M. a heavy squall and shift of wind from S.S.E. to W.N.W. when a strong breeze and heavy head sea, ship standing to the S.E.; noon, Lat. account 6°.30′ S., Long. 81°.20′ E. P.M. Wind S.W. b. S.; midnight, squally and calm.

"*25th November.*—Throughout variable, squally and calm; noon, Lat. Obs. 5°.50′ S., Long. 81°.4′ E.; midnight, moderate and squally weather.

"*26th November.*—Moderate S.S.W. breeze to noon, when Lat. Obs. 6°.24′ S., Long. 82°.53′ E.; 6 A.M. saw the bark Ward, Chapman, from Bombay; 8 P.M. wind S., fresh breeze and cloudy, ship standing to the west and W. b. N.

"*27th November.*—Wind south to noon. Standing S.E. b. E. to 8 A.M., when W. b. N. for 2 hours, and again S.E. b. E., strong breezes and a heavy S.E. swell; noon, Lat. Obs. 6°.36′ S., Long. not given; P.M. to midnight, hard squalls.

"*28th November.*—Wind from S. b. E. to S.S.W. of variable strength, and with thick weather; noon, Lat. 6°.23′ S., Long. 81°.34′ E.; P.M. increasing with a heavy head sea from the southward; from 3 P.M. to midnight, wind S.W. and S.W. b.W.

"*29th November.*—Wind S.W. b.W. to S.S.W. to noon, strong

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breeze and high head sea. Lat. noon 6°.48′ S., Long. 82°.00′ E. P.M. Increasing in puffs westerly and W.N.W. 'very dirty appearance all round the horizon.'

"*30th November.*—Wind N.W. throughout; A.M. increasing to a gale with tremendous puffs at intervals; daylight, heavy gale; noon, hard gale, no observation; P.M. heavy sea in all directions; ship lying-to up S.W. off S.S.W.; 1 and 2 knots.

"*1st December.*—A.M. Heavy gales and a fearful sea running in all directions, lying-to under a close-reefed main-topsail and foresail. 6 A.M. moderating a little. Wind marked N.W. throughout, no observation; P.M. still moderating. Midnight, heavy sea running from the S. westward; wind veering a little to the northward apparently.

"*2nd December.*—A.M. Wind marked north, fresh breeze and cloudy with cross sea; noon, Lat. 9°.56′ S., Long. 81.48′ E.; wind and weather the same to midnight.

"*3rd December.*—Wind marked N.N.E. to midnight, and fine weather; noon Lat. 11°. 7′ S., Long. 80°.49′ E.

By referring to the chart prefixed to this chapter, it will be seen that the ships sailing in the gale, north of the Equator, entered it with the wind upon the port side; and that the ships which entered the gale south of the Equator, sailed into it with the wind on the starboard side.

CHAPTER VI.

STORMS OF THE BAY OF BENGAL.

THIS chapter contains diagrams of storms in the Bay of Bengal, which have been traced by Mr. Piddington. They will be given here, not in the order of the dates when they occurred, but according to latitudes, beginning with that nearest to the Equator. A portion of the valuable reports, collected and published by Mr. Piddington, will be reprinted, as they furnish examples which may be of much use to seamen, and will afford them an opportunity to study the subject for themselves. But many more details of great interest relating to these storms, as well as Mr. Piddington's comments upon them, will be found in the volumes of the Journal of the Asiatic Society.

By taking a general view of the diagrams, it will be seen, that the *northern halves* of whirlwind storms coming from the eastward, make the Indian coast a lee shore, whilst the *southern halves* of whirlwind storms, as they pass over the Birman coast, make that a lee shore. It would seem from the reports of the weather, that after the earliest indications of a coming storm, the wind very frequently blows off shore on the Coromandel coast, just before a hurricane reaches the roadsteads, so that ships, by taking advantage of such

CHAP. VI.

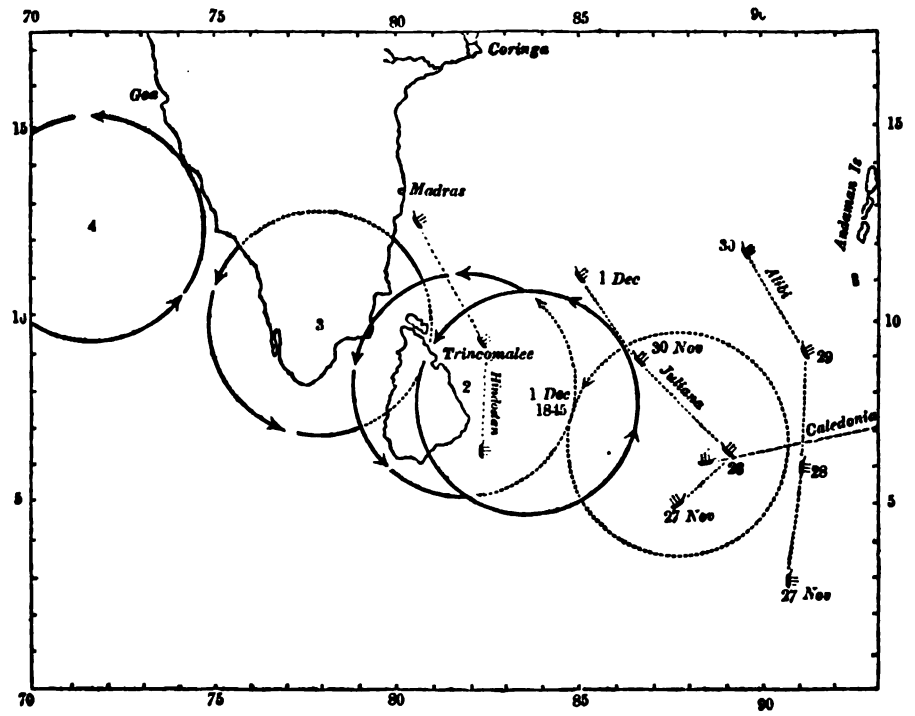
an off-shore wind, would be enabled to get a better offing.

The reports from the interior of the country prove, that the wind in storms is greatly modified by meeting with hills and valleys, and that its force is thereby much diminished. Gales which revolve with strength sufficient to prove disastrous to ships at sea, and which on the level ocean veer with regularity, often pass overland scarcely felt or noticed, except by the fall of the barometer. But although the winds are checked, and their regularity interrupted, the clouds continue their course, and often deluge the country with rain. The degree of knowledge of the winds now arrived at, probably never would have been gained, had the investigation been confined to the study of inland observations. It has been owing to the study of meteorology, being almost entirely confined to observations made on shore, that the variable winds have been looked upon as inexplicable.

Ceylon Gale of December, 1845.

In the work of the late Colonel Capper on the Winds and Monsoons, he says, violent gales are sometimes felt on the east side of Ceylon. But they cannot be of frequent occurrence, as a report from the Master Attendant at Trincomalee states, that previous to 1845, there had not been a *hard* gale of wind there for eleven years. This gale of December, 1845, seems to have originated about the place marked by a dotted circle, two days previous to its passing over Ceylon. It

appears to have been forming there, when the three ships, marked in the following diagram crossed that part.



An extract from the log-book of the steamer Hindostan, shows that this gale had become a whirlwind storm before it reached the land of Ceylon, with force enough to reduce the steamer's speed to two knots an hour, as she was passing across its centre.

This gale was traced by Mr. Piddington over the southern point of India, and on the Arabian sea as far as the seventieth degree of longitude.

CHAP. VI. *Extract from the Log-book of the Steamer Hindostan, from Point de Galle to Madras.*

Hour.	Courses.	K.	F.	Winds.	Bar.	Remarks.
A.M.						Monday, December 1, 1845.
1	N.E.	7	4	N.N.W.	...	Fresh breeze and cloudy. At 2, sounded, 6 fathoms. At 2, latitude by Canopus 6°.27′ north. At 4, sounded in 60 fathoms, no ground. At 5.30, saw the land to the N.W. At 6, saw the Basses right ahead, distant about 2 miles; hauled out to E.N.E. At 6.20, sounded, no bottom at 70 fathoms; when Saddle Hill bore N.N.W., Chimney Hill N.W. ¼ W., and the middle of the Basses N. by W. At 8, cloudy weather; visited ship; squally appearances. At 11, hard rain. Noon, hard squall of wind and rain, with thick uncomfortable weather; found we have experienced a current of 46 miles against us.
2	.....	7	4	.....	...	
3	N.N.E.	7	4			
4	N. by W.	7	4			
5	.....	7	4			
6	E.N.E.	7	4			
7	N.N.E.	7	4			
8	.....	7	4			
9	.....	7	4			
10	.....	7	4			
11	N. by E.	7	4		29·71	
12	.....	7	4			
P.M.						
1	N. by E.	7	..	North.	29.69	Hard squalls from northward, with heavy rain. At 3, passed a small brig standing to the southward. At 5, hands employed lashing and securing every thing on deck and below; carpenters screwing the ports and gangways in. At 8, fresh gale and heavy constant rain; well 2½ inches. 11.30, Strong gale with a heavy swell from N.E., shipping a great quantity of water; put fresh gaskets on all the sails. Midnight, shipped a sea in the saloon through the stern ports.
2	.....	7	..	.....		
3	North.	7				
4	.....	7				
5	N. by E.	7				
6	.....	6	..	.....	29·64	
7	.....	6	..	.....	29·60	
8	.....	5	..	.....	29·50	
9	N.N.E.	5	..	North.	29·00	
10	N.E.	5	..	.....	29·00	
11	.....	3	..	.....	28·90	
12	N.N.E.	3	..	N.E. (Midnight.)	28·90	

Storm's centre.

Distance steamed, various courses, 140 miles.
Longitude chronometer, 82°.10′ east.
Latitude observations, 6°.50′ north.

Extract from the Log-book of the Steamer Hindostan, from Point de Galle to Madras—(continued).

Hour.	Courses.	K.	F.	Winds.	Bar.	Remarks.
A.M.						Tuesday, December 2, 1845.
1	East.	3	..	East.	28·90	Wind lulled suddenly, and shifted round to the southward, and blew a perfect hurricane, veering gradually to the S.E. At 1, running before the wind and sea; the starboard jolly-boat's davit broke, the boat hanging only by the port-tackle and stopper; cut it adrift, as it was beating heavy against the stern. At 1.20, the starboard cutter was lifted by the wind and thrown up on the top of the awning stanchions, and its own davits; secured it as well as possible.
2	North.	5	..	S.W. to S.	28·90	
3	East.	2	..	S.W. to S.S.E.	29·00	
4	North.	5	..	.....	29·25	
5	N. by W.	6	..	S.E.	29·40	
6	.....	6	..	.....	29·54	
7	.....	6	4	.....	29·61	
8	.....	6	4	.....	29·62	
9	.....	7	..	.....	29·62	
10	N.N.W.	7	..	E.S.E.	29·62	
11	.....	7	4	.....	29·64	
12	.....	7	4	.....	29·64	
P.M.						
1	N.N.W. ½ W.	8	..	S.E.	29·74	At 2, the chocks of the fore-yard carried away; secured the yard with fresh lashing. At 4, strong gale, with a heavy following sea; wind veering from south to S.E.; carpenters, with seamen, securing and nailing the skylights, &c. At daylight, got the starboard cutter in board and secured; she is almost knocked to pieces. At 8, moderating. At 9, squally. Noon, squally, with rain; carpenters fitting deadlights, opening ports, &c. At 4, strong breeze and cloudy; rain. At 8, squally from N.E.; visited ship, and found all right. Midnight, wind variable from the S.E.
2	.....	8				
3	.....	8	4			
4	.....	8	4			
5	.....	8	4	East.		
6	.....	8	4	.....	29·80	
7	N.N.W.	8	4			
8	.....	8	4			
9	.....	8	4			
10	.....	8	4			
11	.....	8	4			
12	.....	8	4	.....	29·80	

Distance steamed.—Various, 140 miles.
Longitude.—Longitude by account 10°.20′ E.
Well at 2 A.M.—3 inches.
Latitude observations.—No observations; latitude by account 8°.41′ N.

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Extract from the Log-book of the Steamer Hindostan, from Point de Galle to Madras—(concluded).

Hour.	Courses.	K.	F.	Winds.	Bar.	Remarks.
A.M. 1	N.N.W.	8	4	N.E. to S.E.		Wednesday, December 3, 1845. Moderate wind, with a heavy S.E. swell. At 2, latitude by Canopus 10°.25′ N. At 2, latitude by Sirius 10°.24′ N. Daylight, thick hazy weather. At 8, moderate weather.
2	.....	8	4			
3	.....	8	4	.....		
4	.....	8	4	.....		
5	.....	8	4	East.		
6	.....	8	4			
7	.....	8	4			
8	.....	8	4	.....		
9	.....	8	4			
10	.....	8	4	E.S.E.		
11	.....	8	4			
12	.....	8	4			

Madras Storm, 24th October, 1842.

Plate, page 15.

Mr. Piddington calls the storm engraved on the plate facing page 15, the Madras Storm. It would seem to have originated at the Andaman Islands, and to have moved nearly west by north, across the bay of Bengal and the southern part of India; and afterwards across the Arabian Sea, inclining a little more northerly, in the latter part of its course. Although the information obtained, regarding its progress over the Arabian Sea, is not so full as could be desired, yet there is sufficient to warrant the conclusion, that this storm proceeded onwards to the shores of Arabia, not far from which coast the ships Seaton and Chieftain encountered it, as marked on the chart.

The centre of this hurricane passed over Pondicherry; and as Madras lies to the north of Pondicherry, the wind there would veer from the northward to the east and south-east; and this placed the ships in Madras roads on a lee shore. On the usual signal being made from the shore, nearly all the vessels in the roads got under weigh, and endeavoured to gain an offing from the shore.

Standing off a lee shore in a revolving gale.

Perhaps no question can be discussed which is of more intense interest to seamen, than that of gaining an offing from a lee shore in a storm, with a wind constantly shifting. That which creates the point of greatest interest, as regards the ships which put to sea from Madras roads, on this occasion arises from their having had the land to the westward, with the wind veering to the eastward. They were all in the right-hand semicirle of a whirlwind storm, in which ships on the port tack, by the rule (page 24), fall off. The wind being northerly, in casting from their anchors the commanders had no alternative. They were from necessity obliged to place their ships on the port-tack.

But as the wind veered to the E. and S.E., and the ships broke off, it became of the utmost consequence to wear. The point for consideration therefore on board of each vessel in this situation would be, the time at which the veering of the wind would permit the ship to wear, and to be placed on the starboard-tack, so as to stand to the northward clear of the coast. Whilst on the port-tack the ships were sailing towards the storm's vortex. On the starboard-tack they sailed from it. From published extracts from the ships' log-books, we find that the ship—

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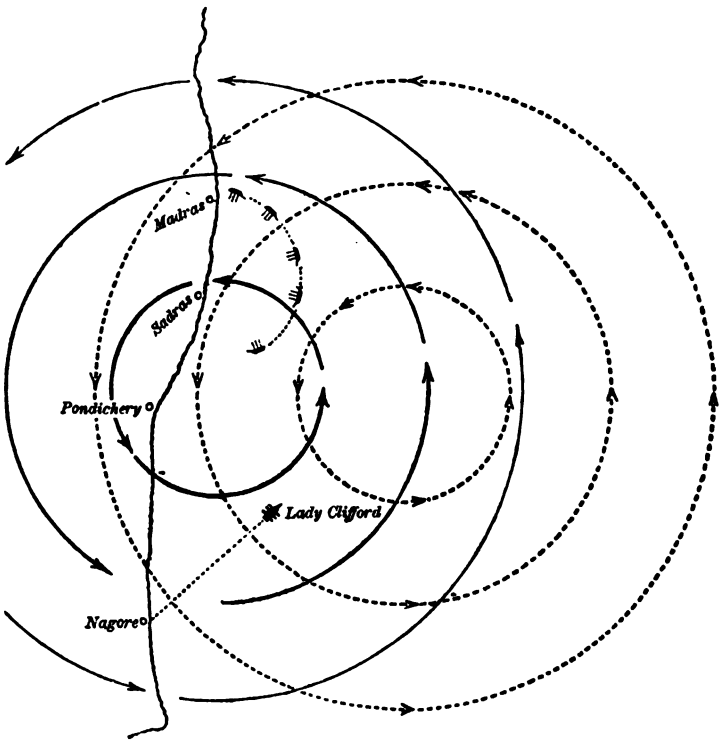
General Kyd wore at ..... 5 P.M.
The Amelia Mulholland endeavoured to wear at 5 P.M. but having shifted her ballast, which consisted of shot and shells, she could not pay off.....
The Neptune wore at ..... 6 P.M.
The Symmetry wore at.....7.30 P.M.
The Columbine wore at ..... 8 P.M.

The dotted lines in the annexed diagram, are intended to represent the hurricane approaching the land, and they show how the wind set in. The dark circles represent the storm's position, when its centre had almost reached the coast near Pondicherry, and they show the wind, as experienced by the ships which



had quitted Madras roads, after it had veered by the E. to S.E. The small figure of a ship sailing in a curved line is meant to represent one of them; as for example, the General Kyd, gradually approaching the storm's vortex, but falling off until her stem pointed on shore, to the southward of Sadras. The degree of curve is probably exaggerated, as a ship's drift to leeward under such circumstances would be very great.

Captain Biden, Master Attendant at Madras, in a communication made to Mr. Piddington, says,

"Official and private reports forwarded with the log-books show, that the barometer did not descend below 29·70, and that a rise was visible at 4 P.M. The gale commenced here about 8 A.M. on the 24th, and then the barometer was at 29·89. We had smart squalls during the preceding night, with much rain, and except at intervals from 6 A.M. till about noon, the weather was thick and hazy. Only two vessels remained in the roads after eleven. The Dauntless slipped at noon; and the Emerald brig having got down her yards, and riding heavily, cut away her masts at 3 P.M., the sea then making a fair breach over her, with two anchors ahead, from one of which she parted. I kept an anxious look-out on the Emerald; saw a light on board of her occasionally; and at 1 A.M., being satisfied that she was safe, I left my office. You will observe by the logs of the respective ships how critically several of them were situated; for instance, the Repulse, General Kyd, and the Amelia Mulholland."

Extract from the official communications sent from the Madras Observatory, to the Master Attendant, from time to time during the storm, 24th October 1842:

Hour.	Barometer	Wind.	Hour.	Barometer	Wind.
At 8 A.M.		N.N.W.	4	29·70	N.E. by E.
10		N. by W.	4.30	29·71	E.N.E.
Noon	29·78	North to	5	29·73	E.S.E.
		N. by E.	6	29·75	E. by S.
1 P.M.	29·75		7	29·79	S.E.
2	29·72	N.N.E.	8	29·84	S.E.
3	29·71	N.N.E.	9	29·85	S.E.
3.30	29·72	N.E.			

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"*Report of the Ship* NEPTUNE, *Madras Roads, 24th October*, 1842.

Neptune.

"The gale commenced with rain and thick weather. At 10 A.M. slipt. At noon, gale increasing, obliged to furl the foresail, then under close-reefed main-topsail, blowing terrifically; head about S.E. and by S. making no head-way, and *gradually breaking off*. At 4 P.M. it cleared up a little, found the General Kyd and a brig close to us. At 6 P.M., ship's head off to S.S.W.; *wore ship* immediately. At 9 P.M. saw the land astern, supposed to be off Coveland: it appeared very near to us. I immediately made sail to get her off the land, the ship's head then about E.N.E. At 11 P.M. fortunately it moderated, *and the ship came up to east*. Midnight out of sight of land. Tuesday, A.M. Weather moderating."

"*Abridged Report of the Ship* GENERAL KYD, *Madras Roads, October*, 1842.

General Kyd.

"At 8.30 A.M. blowing fresh from the northward with heavy swell rolling in, and the barometer being at 29·60, deemed it advisable to slip and stand out to sea. At 9 A.M slipt and stood out to the eastward under double-reefed topsails, wind N. E., ship standing S.E. by E. Sails blowing to pieces. Ship lying over much. Lee gangway under water. Stove in all the butts of water on lee side, and hove spare staves and cotton off orlop deck into the hold. Barometer 29·49. Soon finding the gale increasing fast, tried to heave the lee carronades overboard but could not succeed. At 12·30, in a tremendous squall, washed lee cutter away. Battened hatches down. Water nearly up to main hatch coombings. Barometer 29·44. Sea terrific at 2 P.M. and ship drifting bodily to leeward. At 4, sounded in 35 fathoms water. Attempted again to bend main-topsail without success, but bent the third staysail. Wind E.S.E. Ship's head S. by W. At 5 P.M. gale tremendous, and ship off to S.S.W. Water 17 fathoms. Finding we were drifting fast on shore, called hands aft, and stated that the only chance we had of our lives *was to wear ship;* at the same time telling them that it would be of no use doing so unless we got the main-topsail upon her. The men with one consent said they would do their utmost, and with God's mercy we brought the sail to the yard after wearing ship at 5.30. By 11 at night water 15 fathoms. By 12 o'clock the gale moderated and depth of water was 18 fathoms. At 1 A.M. 19 fathoms. At daylight fresh breeze south-eastward.

Out all reefs and set courses. Stood to the northward, and at noon saw the land about Sadras."

Progress of this storm across India.

In describing the progress of the Madras Storm from Pondicherry over Southern India, Mr. Piddington publishes a very interesting communication received from Captain Newbold, to show how this hurricane seems to have been deflected to the south-westward, by the range of the eastern Ghauts. Captain Newbold says, "From the physical configuration of the country to the north, west, and south of Madras, it strikes me that any aërial current coming from the eastward, would be diverted from its progress in a direct westerly course, by the high line of the eastern Ghauts, and turned in a south-westerly direction by the break of *Salem*, whence sweeping across the plains of *Coimbatore* at the southern base of the *Koonda* and *Nilgherry* escarpments, it would be concentrated on that singular gap in the western Ghauts, the *Paulghautcherry Pass*, whence it would make its escape westerly to the Indian Ocean in the direct latitude of the Laccadives."

Plate, page 15.

Captain Newbold further says, "The exact points where the winds are thus deflected, their minute variations of current, with their various minor influencing causes, are still matters of interesting research and a meteorological desideratum: but that they are deflected, as I have described on the grand scale, by the Ghauts lines of elevation, which constitute the main features of the physical contour of Southern India, there can be little doubt. It is a well-known fact, that where the ridges attain a certain height, neither the north-east nor south-west monsoons usually ascend above them. I was crossing the eastern Ghauts

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at the time of the storm at Madras, a little south of the latitude of Nellore, and observed an enormous mass of irregular clouds rise from the eastward, and advance rapidly on the mountain. Here the great bulk was arrested, and collected into a long, horizontal, wall-like bank, of solid aspect and of deep bluish hue, varied at the edges by flocculent curves, and zones of sombre grey, which appeared in vivid distinctness, as coruscations of lightning shot up, and illuminated portions of the gloomy mass. In height and contour, they assimilated the mural barrier opposed to them. They remained in this sullen form apparently motionless for a day or two, when they gradually dispersed. There was little wind in the sheltered valley along which I travelled, and that little variable. A few detached higher clouds escaped and passed slowly to the westward, whilst portions of the upper edge of the cloud-bank, would sometimes curl over the top of the ridge, like the falling crest of a wave dispersing in spray, and descend in a transient shower on the western slopes. An almost similar phenomenon is presented on the table-lands on the west flank of the eastern Ghauts, on the commencement of the north-east monsoon.

"The almost effectual barrier presented by the eastern Ghauts, to the force of the north-east monsoon, is a proof that this great aërial current is confined, generally speaking, to the lower strata of the atmosphere."

Ryacottah, 3145 feet above the level of the sea, is nearly in the latitude of Sadras.

Bangalore is nearly in the latitude of Madras. Both lie inland about half-way between the two seas.

The barometers at both places, some days before, were about 27.22 inches, and were gradually falling until the 25th October, when

that at Ryacotta fell to .....26·96,

and that at Bangalore to .....26·97.

At both places the wind on the 24th October blew strongly from north, and by the accounts, increased in strength on the 25th. The shifting of the wind was very irregular, most probably caused by its meeting mountains and valleys.

The storm, apparently modified by the Ghauts, did not resume its whirlwind character until it was some distance from the land.

At Mangalore, on the coast of Malabar, which is nearly in the same latitude as Madras, there were strong gusts of wind from the N.W. on the 25th, and strong southerly winds on the 26th.

At Dilly, also on the Malabar coast, which is nearly in the same latitude as Pondicherry, the weather looked very stormy, and the harbour was "most unusually filled with pattamars, which had sought safety from bad weather at sea."

When the ship Futtay Salaam, from Mauritius to Bombay, crossed this hurricane in the Arabian Sea, it had again assumed the character of a whirlwind storm. How far the whirlwind nature of storms is modified by passing over continents, is a subject for investigation. Mr. Redfield remarks, that "storms which pass from elevated lands, or even from low countries, do not often act with great force at the surface of the ocean, till at a considerable distance from the coast; this being especially the case with that side of the storm which exhibits an off-shore wind."

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Futty Salaam.

The Futtay Salaam, from Mauritius to Bombay, first experienced the effect of this storm by the N.W. wind increasing in force, and meeting a "chopping sea" whilst steering N. by E. As she sailed onwards, the swell of the sea increased and the wind veered from W. by N. to S.W. and to S.E. The Futtay Salaam was laid-to "with the wind at south-east blowing a furious hurricane, with a tremendous high sea." By steering the ship more to the eastward, more moderate weather, and still a fair wind for Bombay, would have been obtained. An extract from this ship's log-book follows:

"*Abridged Log of the* FUTTAY SALAAM, *from Mauritius to Bombay, Civil Time.*

"*24th October*, 1842.—Noon to midnight, light breezes from W.S.W. to W.N.W., and fine.

"*25th October.*—From noon, winds W.N.W. to N.W., and fine; 3 and 4 knot breeze. Noon, lat. 7°.55′ N., long. chron. 68°.14′ E. P.M. Moderate, 4 to 7 knot breeze, W.N.W. to N.W. Increasing at midnight, and a 'chopping sea getting up.' Steering to the north by east throughout.

"*26th October.*—Midnight to noon, 6 to 7 knot breeze, with heavy north-west swell, the ship plunging much at times. Noon, lat. by account 10°.16′ N., long 68°.54′ E.; fresh gales west by north. At midnight wind S.W., going from 4 to 6 knots to the north by east, blowing a gale, making all snug; vessel making much water.

"*27th October.*—The gale increasing to a hurricane at S.S.W. At 4 A.M. hove-to. At 6 A.M. blowing a complete hurricane, ship perfectly unmanageable; lashed the helm a-lee. Tarpaulins in the main and mizen rigging to keep the ship to. Noon, gale increasing with a heavy high sea; vessel straining much. Lat. by account 11°.55′ N., long. 69°.09′ E. The ship lying-to, and wind marked S.E., blowing a furious hurricane with tremendous high sea. At midnight a gale, but more moderate.

"*28th October.*—A.M. Moderating, but still dirty, with violent squalls and heavy rain. Daylight, moderating fast. At noon, lat. by account 13°.31′ N., long. by account 68°.09′ E."

Seaton.

The Seaton, from Aden to Bombay, had the wind at first from north by west, *with a head-sea* and falling barometer, along with other indications of a gale. Under such circumstances to have altered her course to south, would have procured for her a fair wind for Bombay, and led her from the track of the storm's centre. By steering in this manner, she most probably would have been saved from the necessity of returning to Aden. The following extract of an account of what befell this ship, published in the *Bombay Times*, is interesting. It seems probable that when the Seaton was nearly thrown on her beam ends, and had all her sails blown away, that she was drifting round the whirlwind, and that this was the cause of the sudden changes of the wind she experienced from N. by W. to E.S.E. and to E.N.E.

The Chieftain, in lat. 13°.5′ N., long. 57°.15′ E., on the 2nd November, had the wind N. by W. veering to W.S.W. and S.W., with a heavy head swell which caused the ship to plunge deeply.

By the latter part of the following extract it will be seen, that there appeared to have been indications of this storm at Aden, and that it caused great losses along the Arabian shore.

"After leaving Aden the Seaton had moderate breezes from the northward, with clear weather; for two or three days before the gale was felt, they had a very uneasy, broken, and turbulent, head sea, with light northerly winds, which enabled them to carry royals and main-skysail.

"On Sunday, the 30*th of October*, P.M., the breeze gradually increased so much as to require the smaller sails to be stowed, topsails double-reefed, mainsail and jib also stowed, wind N. and by W. The atmosphere at this time had a streaky, hazy, troubled appearance. Barometer falling. When the vessel first felt the head sea, the barometer indicated atmospheric derange-

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ment, but not to such an extent as to induce any apprehension of an approaching gale.

"The barometer being a tried one led to the belief that rough weather was to be expected, and preparations were accordingly made to meet it. On Monday the 31st, being then in lat. 14° N., long. 61° E., whilst in the act of taking in all sail, and having succeeded in getting the topsails and foresail clued up, and fore-topsail partly stowed, the hurricane burst in all it fury. In an instant every stitch of canvas was blown from the yards; even the mainsail, though well secured, was blown from the gaskets, went to pieces, and was entirely lost; as likewise every other sail that was stowed. At 9 A.M. the main-top-gallant-mast went by the cap; at 11 the quarter-boat was blown away, with one of the iron davits; at 12, the hurricane still increasing and blowing in furious gusts, the ship was thrown nearly on her beam ends. Ballast shifted, water washing up to the lower deck beams, the sea at this time running high and making a complete breach over her, and from the shifting of her ballast and quantity of water in her hold, she appeared to be bodily settling down. Barometer still falling, and the danger imminent; the mainmast was cut away, after which she righted a little, and rose lighter to the sea; but still with a heavy list to starboard. From the great straining of the ship the water continued pouring in through every seam. At 2 P.M. the fore-topmast was carried away a foot above the cap. At 3 the foremast went, four feet above deck, carrying everything with it; part of the wreck falling across the long-boat and pinnace, stove both at nearly the same time. The mizen-topmast gaff and spanker-boom fell on deck, leaving nothing standing above board but the mizenmast. From the exhausted state of the crew, the heavy rolling of the vessel, and the sea continually breaking over her, it was found impossible to clear away the wreck, which also striking under the counter and different parts of the vessel, threatened serious consequences.

"1*st November*.—At daylight the wind lulled a little. At 8 A.M. the hurricane recommenced with redoubled fury. The wind, which before was N. and by W., suddenly shifted to the E.S.E., and settled at E.N.E. Sea breaking over her fore and aft, making a clear sweep of the deck. It is a matter of surprise and congratulation, that none of the men were washed from the pumps, which were kept incessantly going during the intervals of the sea; the spray was flying so furiously and thick, that the forecastle could not be distinguished, and every part of the body that was exposed smarted from its effects.

Storm's centre.

"On Sunday night, the 30*th*, the barometer fell to 29·7; during the height of the gale its lowest range was 27·6; the 1*st November* it rose to 28in.; it began to rise four hours before the gale moderated.—2*nd*. Moderate breezes, sea going down, all hands engaged in clearing away the wreck, and getting up some spars as jury-masts. Got her before the wind, and bore away for Aden, where she arrived on the 15th in a very shattered state; crew exhausted from having been constantly at the pumps.

"On Sunday evening, the 30*th October*, there was neither cloud nor fog-bank in the western horizon, yet the sun went down fiery red and contracted in appearance. His rays, instead of glancing obliquely across the waves, seemed to dip and lose themselves almost perpendicularly in the *long heavy swell*. During the height of the storm the rain fell in torrents, the lightning darted in awful vividness from the intensely dark masses of clouds that pressed down, as it were, on the troubled sea. *In the zenith there was visibly an obscure circle of imperfect light of* 10 *or* 12 *degrees*. When the hurricane took off, the scene to leeward was awfully grand, thick masses of the darkest purple-coloured clouds were rolling over each other in inconceivable confusion, tinged and lighted up in different places by intensely vivid lightning. The hoarse roar of the retiring storm, mingled with the hollow groan of continued thunder, as they slowly retreated with the gale, left an impression on the mind not easily to be forgotten; the respiration of every person on board was affected: this is to be accounted for by the electric state of the atmosphere, with which all hurricanes seem to be intimately connected, if not entirely excited and influenced thereby.

Centre of storm.

"I subjoin an extract from the log of the barque *Chieftain*, which vessel you will observe was not far from the *Seaton* on the 31st.

"29*th October*.—Lat. 7°.52′, Long. 55°.54′. Light airs, cloudy weather, sea calm.

"30*th October*.—Lat. 8°.26′ N., Long. 56°.46′ E., Wind N.E. and by E., light breeze, cloudy.

"1*st November*.—Lat 11°.12′ N., Long. 57°.15′ E. Wind N. by W. ½ N. to N.W. by W. ½ W., moderate breeze, cloudy.

"2*nd November*.—Lat. 13°.5′ N., Long. 57°.15′ E. Moderate breeze, cloudy, heavy head-swell, ship plunging deeply; ship's head N. and by W.; took in the small sails. Breeze moderate, cloudy, dark gloomy appearance with vivid lightning; latter part

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squally with heavy rain. P.M. Wind W. by N., veered round to W.S.W. and S.W. By this it is evident the *Chieftain* met the sea occasioned by the same tempest.

Arabian coast.

"The accounts received up till this date, from different parts of the Arabian coast, convey intelligence of a great number of vessels having been lost in the same hurricane. These have been large buggalows principally belonging to subjects of the Imaum of Muscat, conveying dates &c., from the Persian Gulf to Aden and different parts of the Red Sea. Fifty-one vessels have been lost to the northward of Cape Issolleta, and between it and Ras-el-had, nine to the southward of Gardafui, ten between Shabal and Aden; making a total of 70 vessels, the crews in most instances saved.

Aden.

"At Aden, the weather, from the 29th October till the 8th November, was stormy, cloudy, and unsettled; the tides rose higher than I have known them to do for the last four years; winds from E.N.E. to E.S.E. During this time, a heavy sea rolled into the Eastern, Molkut, and Bunderamar bays, which made it impossible for any vessel to have ridden at anchor in either place with any degree of safety. Not having had a barometer, I cannot say how it was affected; but I am of opinion it indicated the neighbourhood of the hurricane.

"I am, Sir, your's faithfully,

"JOHN P. MALCOMSOM,

"Surgeon, Political Residency.

"Aden, 27th December, 1842."

Lady Clifford.

An interesting and instructive incident, connected with the Madras Hurricane of 1842, is the manner in which it served Captain Miller, commanding the Lady Clifford, in sailing from Nagore to Madras, as marked on the figure at page 72. Captain Miller lay at anchor at Nagore, which was on the south side of the hurricane, and just a little within its influence, as the diagram at page 72 will show.

It is recorded in his log-book, that the day of the 23rd of October had been fine, with the sky clear, and the barometer standing at 30·05. Towards evening,

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Obtaining a fair wind from the storm.

a thick cloud gathered in the N.E., and a long swell set in from that quarter. At midnight the wind fell light, and drew round to the N.W., whilst the swell from the N.E. increased, and the sky became overcast, with the barometer falling. At daylight on the 24th the barometer was still falling, with the thick bank of cloud in the N.E. growing longer and darker, and the swell from that quarter still increasing. At seven Captain Miller weighed and put to sea, *and stood towards the north-east.* Thus sailing towards the storm, and reducing his sail as he drew nearer to it, until "he could just steer with difficulty before the S.W. wind, with close-reefed topsails sheeted *half home*, canvas furled, and topgallant-masts on deck;" and, guided by his barometer and his own correct knowledge of the nature of the revolving storm, he anchored in Madras roads at 6 P.M., on the 26th of October.

In this manner did Captain Miller sail round the east side of the storm, having the wind changing as below.

Hour.	K.	Course.	Wind.	Bar.
A.M.				
1	...	At anchor.	.....	29·90
2	...	.....	.....	29·85
6	...	.....	.....	29·85
7	...	Weighed.		
8	3	N.N.E.	W.N.W.	
9	4	N.E. by N.		
10	5			30·00
11	6	N.E.	West.	
12	7		W.S.W.	30·00
P.M.				
2	8		S.W.	
3	7		S.W.	
5	7	N.E. by N.		29·70
6	7		S.S.W.	Rising.
7	7	N.N.E.		
8	7		South.	
9	7			29·80
10	7		S.S.E.	
12	7		S.E.	29·90
Midnight.		Out close reefs and set foresail.		

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The dotted circles on the figure at page 72 will show the relative positions of Nagore, and the storm at 7 A.M., when Captain Miller put to sea; and the dark circles, which have their centres near Pondicherry, will serve to represent the storm at 8 P.M., when the wind with the Lady Clifford had become south.

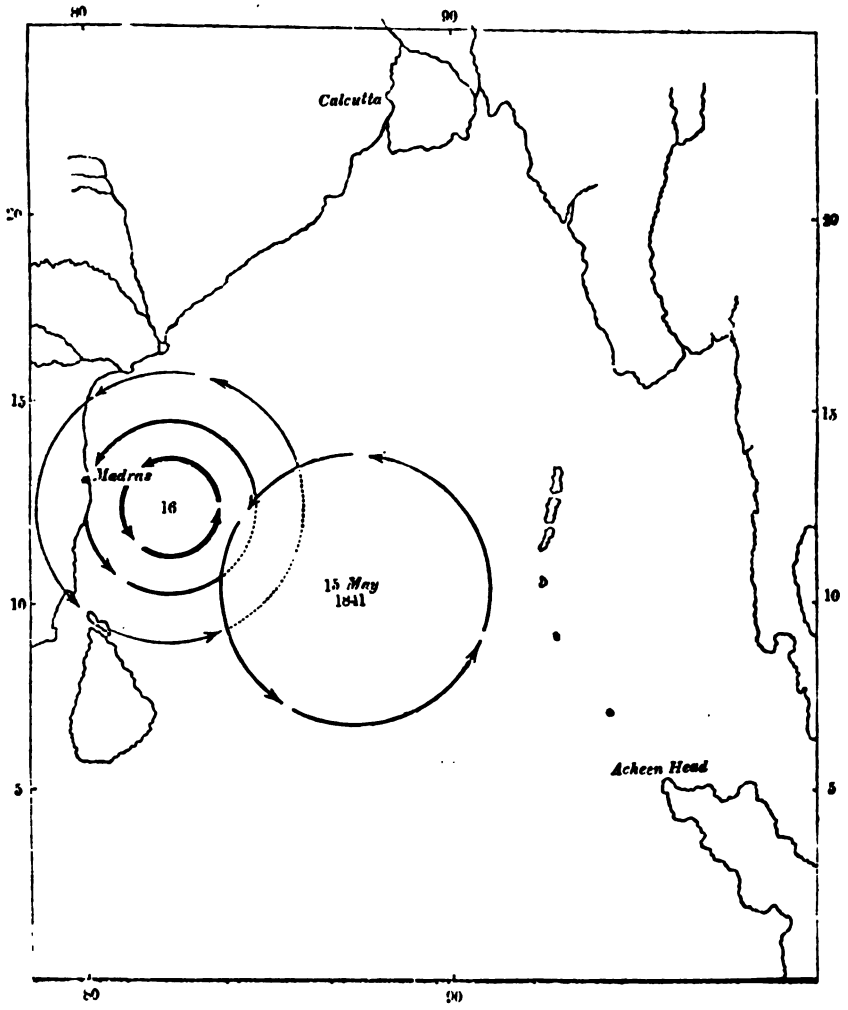
This voyage was performed at the period of the north-east moonsoon, when under ordinary circumstances the voyage from Nagore to Madras would have been a tedious one. It is an instance of what will be enlarged upon, when I endeavour to point out the advantage to be derived to navigation, by sailing on curved courses, when meeting with revolving winds.

The contrast between the movements of the two ships, represented in the diagram referred to, is very striking, and the detailed accounts are of deep interest.

Madras Gale of the 16th of May, 1841.

On the 16th of May, 1841, the centre of a whirlwind gale, coming from the S.E., passed over Madras. The annexed figure is intended to represent it in its progress, and is constructed from Mr. Piddington's chart. Although not a violent hurricane, it was sufficiently severe to cause the ships in Madras roads to put to sea; and one or two vessels, with several native craft, were lost on the coast. The report of the commander of the barque Tenasserim, is printed in pages 86—88, as an example of the wind and weather the vessels which stood out from the roads met with. Read along with the diagram, it will enable sea-commanders

to consider whether, in a similar case, it might not be better to run to the southward.



A report from the Assistant Surveyor-General will explain in what way this gale was felt at Royacottah and Bangalore. This report will serve as an example to prove how greatly gales are modified on land.

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Extract of a letter from Captain Biden to Mr. Piddington:—

"Master Attendant's Office, Madras, June 2, 1841.

"You will have heard of our gale on the 16th: it was partial, and did not blow very hard here. It seems that the vessels which slipped from the roads experienced more severe weather outside. All the 15th the weather looked suspicious, cloudy, gloomy, and the atmosphere very close. On that evening I despatched a circular through the fleet, advising a good look out, and due preparation in cases of emergency. The barometer continued nearly stationary until noon on Sunday, when the surf rose, the breeze increased, and the barometer fell. I made signals first to prepare, and in an hour afterwards to cut or slip. It blew fresh from N.N.E. at this time, 1 P.M.; and at 4 P.M. there was much thunder and lightning, with rain. At 7 the gale increased; and about 8, amid torrents of rain, and with a short hull, the gale flew round to the S.S.W., blowing furiously for an hour. At this time the report from the Observatory stated—'We expect a perfect hurricane; be prepared.' I was on the beach all night, and at 11 the barometer had risen considerably, the wind abated, and towards daylight we had a strong southerly wind, with fair weather."

State of the barometer from the Surveyor's Observatory, on May 16, 1841:—

"10½ A.M.	..	..	..	29·6505
11	..	..	..	·6206
12 noon	..	..	..	·5550
2 P.M.	..	..	..	·4625
4h. 41m.	..	..	..	·3190
5h. 41m.	..	..	..	·2710
6h. 41m.	..	...	..	.1227
6h. 56m.	..	..	..	·0690

the lowest, after which it began to rise."

Barque Tenasserim's report:—

Tenasserim.

"*Saturday, 15th May*, 1841.—First part, N.W. and N.N.W. breezes, and a confused sea. Midnight, blowing hard; veered away chain to 65 fathoms.

"*Sunday, 16th May.*—From midnight, blowing hard, with a

heavy sea getting up; daylight, blowing very hard from N.N.E., with heavy appearance, and every indication of an approaching gale. About noon, agreeable to instructions per signal from the shore, let go the best bower. At 1 P.M. a very heavy sea struck the ship, carried away all the palls of the windlass and the starboard hawse-pipe, and parted the larboard lower chain; finding ourselves in a very critical position with regard to the *George the Fourth* Indiaman, thought it most prudent to run to sea. Set the foresail, fore-topmast-staysail, and close-reefed maintop-sail and trysail, running E.S.E. At 5 P.M. the gale suddenly abated, and veered round to the S.E.; immediately wore ship to the S.W. Scarcely had we wore round, than a tremendous squall from S.E. caught the ship, and laid her on her beam ends for a quarter of an hour, split the foresail to ribands, and also the lee-clew of the main-topsail; whilst in this position, the jollyboat was unhooked by the booms, and fell in the water bow foremost, carrying away the topping lifts and guys; was unable to recover her whilst in this state, therefore cut away the stern falls. About 6.30 A.M. a tremendous sea struck us on the larboard quarter; capsized and broke the companion hatch; put the chronometer for safety down below; tremendous hard squalls from the southward; running east under bare poles, the main-trysail being split; observed running, apparently before the wind, a barque, which obliged us to keep away and show a light; she passed within a quarter of a mile of us. At 8 P.M. lashed the helm 'a-lee,' and set the fore-topmast-staysail, shipping immense quantities of water in every direction. Midnight, blowing a hard gale from S.S.W., with a confused sea. During a severe squall the jib accidentally got adrift, unperceived by any one, and was unfortunately nearly all blown away. During the height of the gale the barometer was 28·60.

On port-tack and head to storm.

"*Monday, 17th May.*—A.M. Very hard squalls with a heavy sea; vessel labouring heavily (but perfectly tight); gale somewhat abated. About noon a fresh gale, and cloudy weather. Lat. obs. 63°.11′ N., Long. by chron. 81°.29′ E. 7.30, very heavy threatening appearance in S.W.; wore ship to the E.S.E., and furled the fore-topsail; blowing a hard gale with a heavy confused sea, making breaches in every direction; a great quantity passed below, through the companion hatch, though every precaution was used, by nailing planks and double tarpaulins over it. Midnight, ditto weather. Barometer these 24 hours very unsettled; at midnight, 28·80.

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"*Tuesday, 18th May.*—Blowing a hard gale with a high rolling sea, causing the vessel to lurch very heavily. At 1, bar. 29·00; at 2.30, fell to 28·80; at 3, blowing very severely, with a clear sky; 4, moderate; 5.30, wore ship to the westward; daylight, moderate and clear, out close reefs; 7, wore ship to S.E., out all reefs; noon, a fresh breeze from the S.W., with a decreasing sea. Lat. obs. 13°.16′ N., Long. by chron. 82°.18′ E."

Observations inland.

Report from Captain Campbell, Assistant Surveyor-General, Madras:—

"I have the honour to report that the barometers at Royacottah and Bangalore were affected by the storm which took place at Madras, at 2 A.M., of Sunday, the 16th May, 1841; and that at Royacottah the force of the gale was felt for some hours.

	10 A.M.		4 P.M.	
Date.	Royacottah.	Bangalore.	Royacottah.	Bangalore.
12	27·113	27·148	26·991	27·041
13	27·055	27·126	26·949	26·974
14	...	27·070	26·937	26·958
15	27·023	27·056	26·911	26·948
16	26·963	26·972	26·859	...
17	26·901	26·956	26·843	26·888
18	26·963	27·007	26·883	26·923
19	27·035	27·083	26·935	26·984

"The very slight variations in the difference of the observations between the two instruments, at the distance of 40 miles, show that the observations deserve the utmost confidence. The greatest depression observed was at Royacottah, on the 17th, being 0·212 inch below the pressure on the 12th.

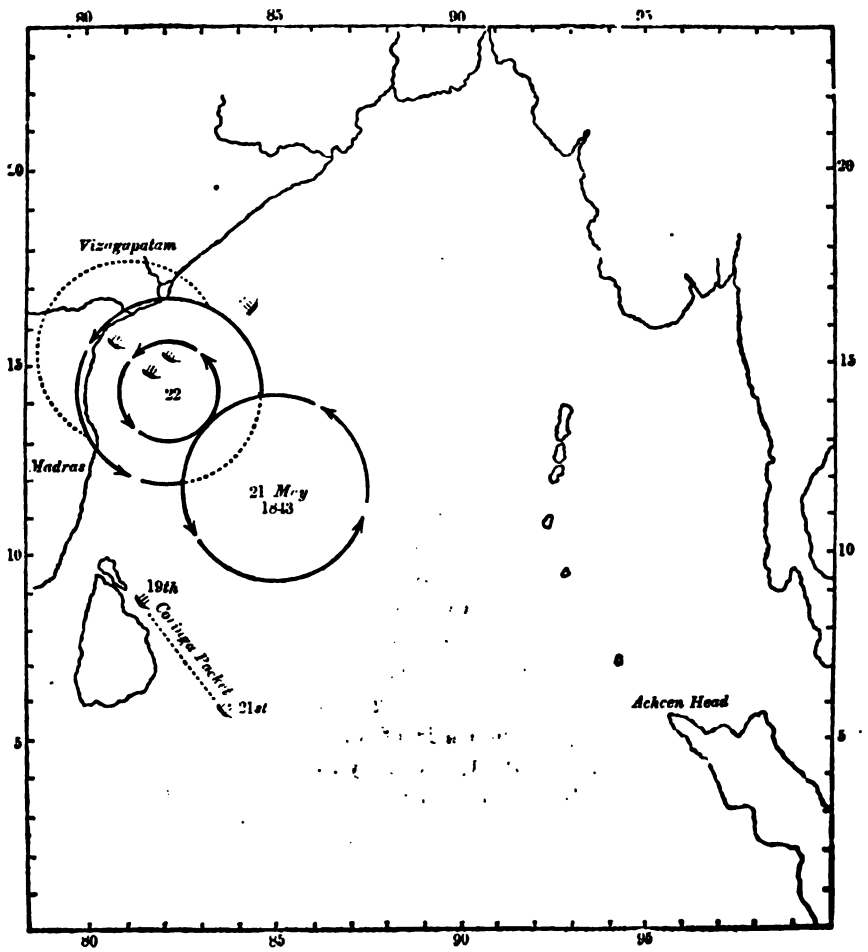
"Observations on the weather at Royacottah on the 16th, at 10 A.M.

"Wind N.W., overcast with nimbi. Thick in N.E., lower stratum of clouds moving rapidly with a N.E. current. Rain N.E. and S. at a great distance, 40 miles; air very clear. At 4 P.M. overcast, wind at north; drizzling and heavy rain. About 2 in the morning wind increasing to a gale; direction not certain, believed S.E. 17th, at sunrise, wind quite fallen.

"At Bangalore, 16th May, 10 A.M., wind moderate; very cloudy and oppressive. At daylight, 5 A.M., barometer 26·868; rain at night. On the 17th, at 10 A.M., very high wind; stormy. It is to be noted, however, that in this month very high winds prevail at Bangalore."

Mazulipatam Storm, 22nd May, 1843.

On the 22nd May, 1843, a storm coming from the south-eastward, reached the coast of India, between Vizagapatam and Madras, as represented by the annexed diagram.



The General Kyd putting to sea from Madras roads on the 21st of May, 1843, with the barometer falling and wind at N.N.W., steered east by south. This fur- General Kyd.

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nishes an example of a ship that would have done better had she scudded before the wind in the first instance. In the season of the north-east monsoon, a ship under similar circumstances might have continued to scud before the wind, being guided by its strength and direction, and by the barometer, so as to avoid the storm's centre. Sailing round the storm would carry her to the N.E., and give the best chance of a fair wind to return to Madras. But during the season of the south-west monsoon, a ship under such circumstances leaving Madras, might steer so as by degrees to bring the wind upon the starboard quarter, and by keeping to the south avoid the stronger part of the gale.

It will appear by the report of this ship, that she was hove-to upon the port-tack.

Abridged report from Captain Onslow of the ship General Kyd, to the secretary of the Marine Board at Calcutta.

"The General Kyd, of 1318 tons old measurement, left the Bengal Passage, Acheen Head, on the evening of the 9th of May, civil time, with a pleasant breeze, and very sultry weather, from the N. E. This continued for some days, with squalls and variable weather sometimes, throughout the passage from Acheen to Madras. The weather continued so unsettled, though the barometer continued high, being between 29·70 and 29·90, that I was led to apprehend a gale of wind during the whole passage of eight days. On the 19th of May I anchored in Madras Roads, and immediately received a note from the Master Attendant, to be prepared for bad weather. On the 20th May the weather was squally and unsettled from the northward; the barometer, 29·70. In the evening appearances becoming more favourable, I did not leave the shore. But on the morning of Sunday the 21st, the sea, which is a sure forerunner of a gale on that coast, rose tremendously high, insomuch that I was once capsized in trying to get through the surf, and was very nearly one hour and a half in getting through the second time, with the boat nearly full of water. At noon got on board the ship, the wind then from

N.N.W. blowing fresh. Slipped the cable and made sail. Stood E. by S. At 3 P.M. wind gradually increasing with thick rain at times, and most turbulent sea. At 7.30 P.M. much lightning to the eastward, but the sky gathering up thick to the westward, and very unsettled and squally, with a furious sea. At 8.30 a tremendous squall, and sudden shift of wind to W. by N.; clewed up and with difficulty furled the maintopsail, and rounded-to with the head to the N.E. Ship labouring awfully. Continued strong gale, and tremendous sea, till about 2.30 A.M. on the 22nd, when the wind in a tremendous squall, *shifted suddenly* to the S.W. by W. causing the sea to rise in perfect mountains, and in a most confused irregular manner; the ship then rolling and plunging so, that I sometimes thought she would not recover herself. About 3.30 the mainmast went over the side, followed by every stick except the foremast, bowsprit, and foreyard; the ship then rolling her gunwales under. The strength of this hurricane lasted till about 8 A.M., when it became a little more moderate, but the sea running with unabated fury. Had no observation that day, but the reckoning at noon made us about 68 miles E. ½ S. from Madras. Soon after sunset the wind and sea moderated a little, and on Tuesday the 23rd we were enabled to get a foresail bent, and set as much sail in various ways as we could. At noon by observations found ourselves in lat. 13°.47′ N., long. 82°.3′ E.; barometer, 29·44. The breeze settled into a fresh monsoon from S.W. to S.S.E., which weather continued pretty steady till the 31st May, when we made the light vessel at the Sand Head."

On port-tack.

State of the barometer on board the General Kyd during the gale.

May 21st,	Noon	29·45
„	3 P.M.	29·38
„	5 „	29·28
„	7 „	29·26
„	9 „	29·19
„	11 „	28·17
„	Midnight.	29·11
„	2 A.M.	29·11
May 22nd,	Noon	29·18
„	2 P.M.	29·19
„	5 „	29·27
May 23rd,	Noon	29·42

Thermometer ranging from 82° to 88°.

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Teazer.

The transport, Teazer, having sailed from Madras towards Penang, met this gale in its progress coming from the south-eastward. At the beginning of the gale on the 20th, this ship had the wind at N.N.E. changing to N.W., after which she steered E.S.E. This course would carry her towards the track of the gale's centre. It will be seen that she experienced very bad weather, broaching-to whilst scudding. She was then in the south side of the gale, and therefore, had she been kept more to the southward, she might have preserved a fair wind for Penang, and at the same time found moderate weather.

"*Abstract of the Log of the Transport Barque,* TEAZER, *from Madras to Penang, with troops on board, reduced to Civil Time.*

"19*th May,* 1843.—At noon, Lat. 12°.00′ N., Long. 81°.28′ E.; Bar. 29·72, Ther. 86°. Weather very threatening and winds variable; hove-to; the wind not marked but apparently from S.W. to S.S.W. At 3 P.M. made sail; winds to midnight marked about S.E.

"20*th May.*—Shortened sail, and hove-to again at noon in consequence of the threatening weather and disturbed sea. Wind marked as variable, from E. to N.N.E. Noon, no observation. Lat. account 11°.18′ N., Long. account 82°.40′ E.; Bar. 29·70, Ther. 86°. P.M. Every appearance of bad weather, wind increasing to a strong gale from about N.W., violent squalls and rain. Wind not marked, but from about 9 A.M. 'running free;' course E.S.E. 8 knots to midnight, under close-reefed main-top-sail, foresail, and fore-topmast staysail, gale increasing fast.

"21*st May.*—2 A.M. 'Scudding almost before it;' course E.S.E. 9 and 10 knots, hence wind W. by N. or W., but not marked; at 8 a very violent squall W.N.W., veering to S.W. 11h.30m. foresail blew from the yard; ship scudding 12 knots; broached to. Noon, hove-to, a complete hurricane.

"Barometer	2 A.M.	29·70
,,	6 ,, ...	29·40
,,	8 ,, ...	29·3
,,	Noon	29·20

Noon, Lat. account about 10°.43′ N., Long. 85°.4′ E. P.M. Gale continuing, wind not marked.

"22*nd May*.—At 7 A.M. gale a little moderated. Noon, Lat. indifferent observations 11°.25′ N., Long. 85°.10′ E.; Bar. 29·60. P.M. Wind marked S.S.W., and at 5 P.M. S.; gale moderating to midnight; making sail and repairing damages.

"23*rd May*.—More moderate, wind still (apparently) south. Noon, Lat. by account 11°.58′ N., Long. 86°.27′ E.; Bar. 29·66, Ther. 86°. P.M. Moderating, but still threatening.

"24*th May*.—Fine. Noon, Lat. 11°.10′ N., Long. 88°.37′ E.; Bar. 29·68, Ther. 88°."

A lee shore.

The ships Euphrates, Lord Elphinstone, Lord Lynedoch, Candahar, and others, were off the coast about Masulipatam when the storm approached. Its centre being to the south, the coast was to them a lee shore, with the wind veering from north-east to east and to south-east. They were in a situation similar to that of the ships which put to sea from Madras roads on the 24th of October, 1842. I reprint some of the narratives collected by Mr. Piddington, that practical seamen may have an opportunity of studying them for themselves.

The commander of the Lord Lynedoch states, that when the intermitting gusts were strongest they felt alternately hot and cold.

Three ships in the preceding figure mark the predicament in which vessels are placed, when in the northern half of a hurricane upon the coast of Coramandel, with the wind at north-east veering to east. A fourth ship in the figure represents a vessel steering north-east, after the wind has become southerly.

"*Abridged Log of the Barque* EUPHRATES, *Captain* WILSON, *from London bound to Calcutta, reduced to Civil Time.*

Euphrates.

"19*th May*, 1843.—To noon fine weather from E. to N.E. by E., which had also been about its direction for the preceding

[illegible], Lat. 14°.51′ N., Long. 81°.28′ E. P.M. to [illegible] same winds and weather.

[illegible].—Winds from N.E. to N., freshening from north [illegible] from Lat. 16°.2¼′ N., Long. 81°.40′ E. At 10 A.M. [illegible] W. ½ N. 10 miles. P.M. Moderate breeze [illegible] increasing at 8, with thunder, lightning, and rain. Midnight [illegible] menacing appearance. Wind E.N.E., making all [illegible] standing to the S.E.

[illegible] May.—By 6 A.M. hard gale E.N.E. 10 A.M. variable. [illegible] N.E., hard gale and squalls with heavy rain. Lat. by observation 14°.40′ N., Long. 82°.52′. 'An easterly current the last 24 hours, the high easterly swell *preceded* the wind about four hours, and the sea got up very rapidly with the wind.'* Noon, barometer 28·90, sympiesometer 28·80. P.M. Hard gale N.E., high cross sea. Midnight, very hard gale. Wind at 9 P.M. easterly. Midnight, E.S.E.

"22*nd May*.—5 A.M. blowing a hurricane. 7 A.M. wind S.E. by S.; wind drawing S.E. and southerly in the squalls. Noon, wind S.S.E., hurricane still continuing. Latitude account 14°.08′ N., Long. 82°.29′ E. P.M. Continued heavy hurricane at south. *Hail* and rain at 1 P.M. 6 P.M. barometer rising rapidly; wore and bore up to the N.E. by E. 7 P.M. wind S.S.W. 8 P.M. barometer, 29·20. Midnight, hard gale and heavy squalls.

"23*rd May*.—2 A.M. wind S.S.W. 6 A.M. to noon, moderating, and sail was gradually made. Wind S.S.W. Lat. observation 16°.17′ N., Long. 83°.44′. 'A set of 62 miles south, 69° E., in the last 48 hours.' To midnight variable and squally from S. to S.S.W."

"*Abridged Log of the Barque* LORD ELPHINSTONE, *Captain* CRAWFORD, *from Madras towards Vizagapatam, Civil Time. Forwarded by Captain Biden.*

Elphinstone. "21*st May*, 1843, *Sunday*.—First part, cloudy weather with wind from N.N.E. to N.E. Barometer falling from 29·98 to 29·55. At 3 P.M. dark gloomy appearance, with sudden gusts of wind; prepared for bad weather. At 11 P.M. severe squalls. Midnight, strong gales from N.N.E. to N.E., veering between the

* This remark is worth attention. The easterly set was probably the outpouring of the Godavery. H. P.

two points. Bar. middle part, 29·50 to 29·42; latter part and noon, 29·20. Lat. 15°.45′ N., Long 83°.15′, by dead reckoning.

"22*nd, Monday*.—Severe gales from N.E. to E.N.E. and E. At 10 A.M. blowing very hard with a high sea; at 10.30 severe squalls split the double-reefed topsails; barometer 29·80; hove the ship to with a tarpaulin on the weather mizen rigging; at noon terrific squalls; got the anchors secured with extra lashings, ship behaving very well. Barometer from 28·80 to 29·0, 28·90, and 28·80. At 1 P.M. a heavy sea struck the back of the rudder, carried away some of the pintles and gudgeons; got a hawser passed over the stern to keep the rudder steady; at 2, if possible, blowing harder, the lee side of the forecastle and top-gallant-rails under water; wind veering from E. to E.S.E. and S.E., blowing very severely.

"23*rd, Tuesday*.—Barometer at 2 A.M. 28·75, wind hauling to S.S.E.; the hawser securing the rudder cut through, the rudder now beating from side to side at a most fearful rate, making all tremble; at 5, wind south; at 6, broke down the after cabins to get at the rudder; all the pintles being gone, with the exception of the upper one; succeeded in lifting it out, and letting it go clear of the ship. 8 P.M. wind moderating at S.S.W. Midnight, ditto. Barometer, 29·0 to 29·5 and 10.

"24*th, Wednesday*.—Ship making a great deal of water; observed the counter stove-in, and the rudder-case all started, in consequence of the time it took to get clear of the rudder; all hands, with the passengers, employed at the pumps. At 2, getting more moderate, commenced making a jury-rudder, with the spanker-boom for a main-piece, and 20 fathoms of chain-cable.

"25*th, Thursday*.—Employed at the pumps and rudder; got it over, and made sail. Lat. 16°.18′, Long. 83°.18′.45″ E.; deemed it proper to haul up for Coringa to repair damages. At 4 P.M. sighted Coringa Light. Noon, anchored in the Roads, the crew quite exhausted from incessant labour."

"*Extract from the Log-book of the Barque* LYNEDOCH, *from Madras, towards Vizagapatam, reduced to Civil Time. Forwarded by Captain Biden.*

"19*th May*, 1843.—1 P.M. winds E.N.E., steady breeze, and fine weather; 6, steady breeze and cloudy; 8, squally; 10, wind E. by S. Midnight, squally, with rain; wind E. by N. Lynedoch.

"20*th*.—2 A.M. increasing winds and squally, with lightning

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to the eastward. Daylight, decreasing wind, and cloudy. At 8, Wind E.N.E. At 10, squally. Noon, steady breezes and fine. Lat. by obs. 13°.42′ N. P.M. Wind E.N.E. At 4, increasing breezes. At 8, fresh wind and cloudy, with lightning. At 10.30, strong breezes and squally. At midnight, the same.

"21st.—A.M. Wind N.E. by E. At 3, strong gales. At 11, severe gales, wind E.N.E. Noon, increasing gales, and very severe squalls; sun obscured. P.M. Wind E.N.E.; strong gales and squally. 5.45, increasing gales and severe squalls. At 8, severe gales and thick hazy weather. At 9, increasing gales, and very severe squalls with rain; laid the ship to under close-reefed-trysail, and double-reefed the spanker. At midnight, strong gales and very heavy squalls.

22nd.—At 4, increasing gales, and very severe squalls with rain. Daylight, heavy gales, and very heavy squalls. At 8, blowing a tremendous hurricane. At noon, the same. P.M. wind N.E. by E. At 30 minutes past noon, wore ship. At 1 P.M. shift of wind from westward, and the ship under bare poles. At 3, wind W.S.W. At 4, blowing a tremendous hurricane, and the ship lurching very heavily; filled the larboard quarter-boat; cut her away. At 4.30, ship lurching very heavily; greatly damaged starboard quarter-boat; prepared axes to cut away the masts if necessary. At 5, carried away the spanker-gaff. At 6, the hurricane abated a little. At 8, very strong gales and severe squalls, with thick hazy weather. At midnight, the same.

Wore.

23rd.—Daylight, inclining to moderate. Noon, decreasing wind; sun obscured. At 7 A.M. wind S. S.W. At 10, S.W."

The following remarks were subsequently obtained from the commander of the Lynedoch.

"At 10 A.M., on the 22nd, the barometer was at 28·35, and by three quarters past noon it fell to 27·95. The strongest gusts were about 1 P.M., when there were intermitting severe gusts, accompanied with great and terrible heat; and there were alternate gusts of heat and cold, after the hurricane veered to S.W. When the shift of wind took place, which was preceded by a dead calm, lasting three-quarters of an hour, the barometer being at its minimum, a tremendous cross sea arose, but the swell from the S.W. soon subdued that which had got up from the eastward."

Hot and cold gusts.

This storm, inland, seems to have passed in the direction of Hyderabad, where the wind changed from N.E. to N.W. and S.W. The effect of the rain was very destructive in the interior of the country, and the accounts exemplify what was stated above, namely, that although the winds are checked, and their regularity interrupted by hills and valleys, yet the clouds continue in their course, and often deluge the country with rain.

A fall in the barometer appears to have occurred at this period over the greater part of India.

Extract from the BOMBAY TIMES, *24th May*, 1843.

"THE WEATHER.—Since the evening of Thursday the sky has looked so troubled, and the barometer fallen so steadily, that we supposed the monsoon to be at hand. The wind has got round nearly to south-west, and alternating land and sea-breezes have ceased. Our sea-breeze, which blows with so much regularity from the north-west for seven months in the year, has disappeared. On Sunday evening some light showers fell, and the sky has ever since continued black and cloudy. The most singular phenomenon of all is, the remarkable and steady fall of the barometer, which has been gradually sinking for four days, and has now got to a point rarely attained by it. The following are the readings of the Observatory standard since Thursday, when it began to fall. They are given both as read from the scale, and as corrected for temperatures, capillarity, &c. The hours are very nearly those of daily maximum and minimum:

		4 A.M.		10 A.M.		4 P.M.		10 P.M.	
		Read	Cor.	Read	Cor.	Read	Cor.	Read	Cor.
Thursday	18	29·736	29·586	29·792	29·633	29·686	29·529	29·722	29·568
Friday	19	·678	·526	·746	·594	·462	·488	·710	·557
Saturday	20	·688	·538	·769	·586	·632	·475	·710	·555
Monday	22	·575	·421	·630	·471	·494	·338	·566	·411
Tuesday	23	·510	·357	·572	·412	·489	·331		

As no tempest has presented itself here, such as these indications would have inclined us to expect, we are led to infer that within the

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last four days a hurricane has been raging within a few hundred miles of us, the effect of which has only been manifested here on the barometer. The influence of the Madras hurricane, last October, was very conspicuous, but nothing like this."

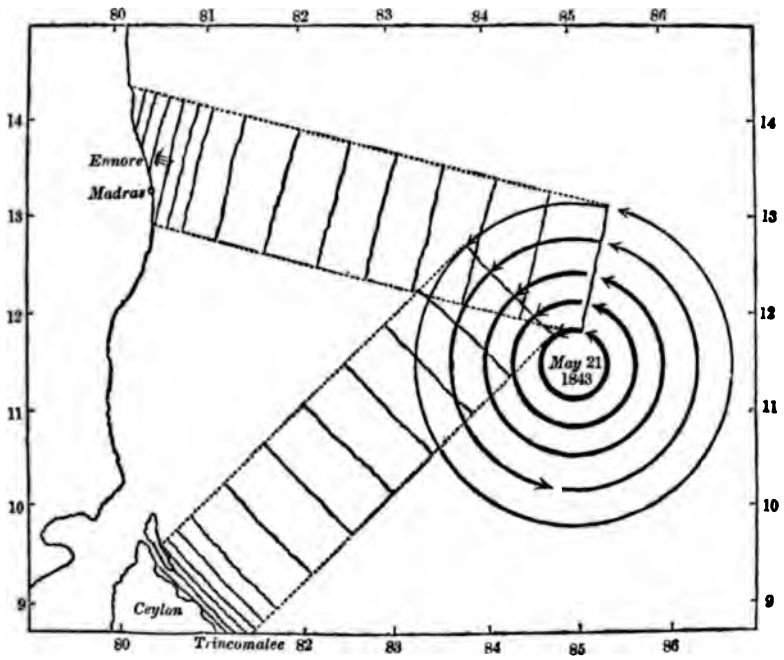
From a Local Newspaper called the SPECTATOR.

"We regret to learn, by a letter dated Poorshottapolium, 27th May, that terrible destruction has been caused in the Guntoor district in consequence of the inundation attending the late storm; many villages having been swept away or sustained great damage by the floods which came down suddenly on the morning of the 23rd. Swelled by the previous rains, four nullahs and sixteen tanks near Inacondah, overflowed or swept away their banks, causing a lamentable loss of life and property, of which the following details are given.

"Rajahpett, 300 houses destroyed or injured, seven lives lost. Poorshottapolium, 208 houses injured, seven lives lost. Chilkloorpett, 300 houses injured, two lives lost. Pusmorroo, 20 houses injured, four lives lost. Annanarum and Toolapanee, 200 houses injured, and seventeen lives lost. In addition to the above damage, or destruction of above a thousand houses and the loss of 37 lives, it is stated, that 2800 head of cattle and horses, and 9000 sheep perished, and that 2700 candies of grain were more or less injured. The whole amount of damage being estimated by our informant at above 100,000 rupees. The total destruction occasioned by the inundation, was indeed hardly ascertained; many villages having been damaged or swept away, of which no perfect account had yet been received."

Swell.

It was during the passage of this hurricane across the Bay of Bengal, that the brig Orpheus, lying at Ennore, with the wind off shore and westerly, experienced a very heavy swell setting in from the east. I shall here print an extract from the log-book of the Orpheus, and repeat the figure given in a former chapter.



"*Extract from the Log of the* ORPHEUS. CHAP. VI.

"21*st May*, 1843.—Strong gales, heavy rain with thunder and lightning. Wind N.W and W.N.W. throughout; but a *strong swell setting in from the eastward*; heavy gales continuing to midnight. Barometer 29·4.

"22*nd May*.—A.M. Wind N.W. P.M. W.N.W.; and W. at midnight. Strong gales throughout, and heavy *swell from eastward*. Barometer 29·3

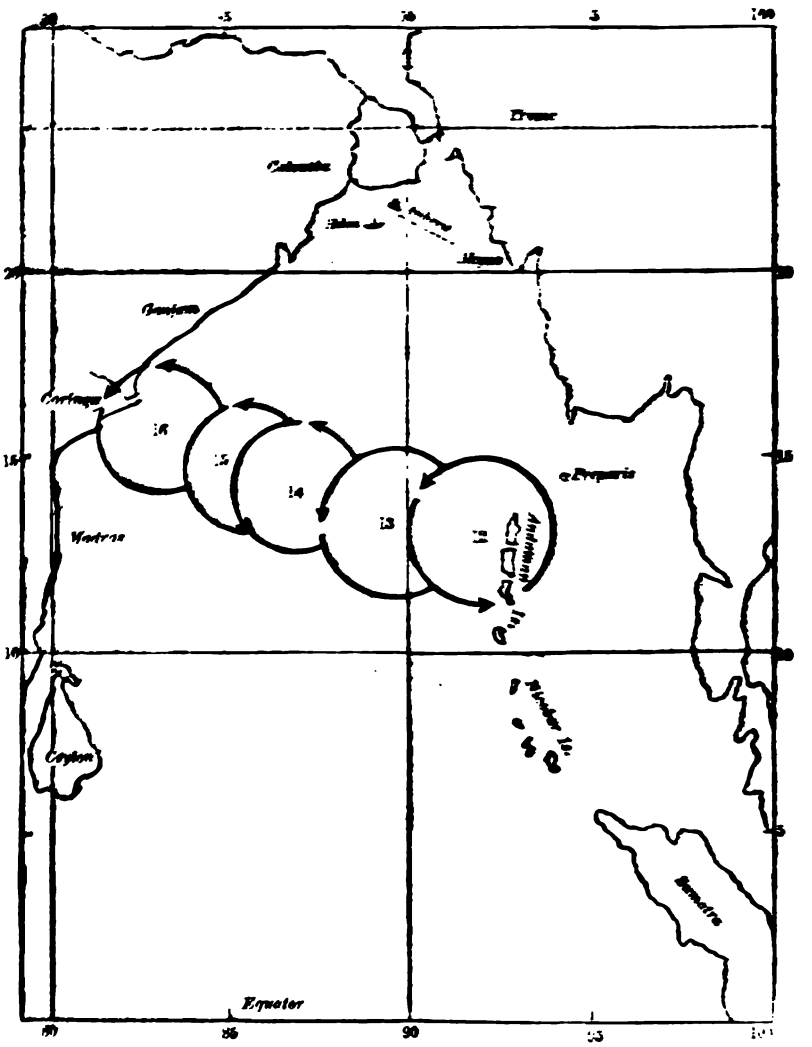
"23*rd May*.—The strong swell from the eastward noted as going down. Winds W., W.S.W., and finally S.S.W. Barometer A.M. 29·4, and P.M. 29·5."

The Amelia Thompson foundered at sea about 80 miles east by north of Madras.

The Coringa Hurricane, November, 1839.

The Coringa Hurricane of the 16th November, 1839, has been traced by Mr. Piddington, from the Anda-

CHAP. VI. man Islands across the Bay of Bengal, to the shores of India about the mouth of the River Godavery. The annexed wood-cut will show its progress from



these Islands to Coringa. The numbers marked near the centre of the circles, denote the daily progress of the storm, across the Bay of Bengal, as obtained from

log-books of ships, beginning with the 12th of November. Mr. Piddington is of opinion, that the violent portion of the storm diminished in diameter, but increased in force, as it approached the Indian shore. It was there a tempest of the most violent kind.

Storm wave.

In the 2nd edition of the Attempt to Develop the the Law of Storms, I suggested the probability, that the diminished atmospheric pressure, accompanying progressive revolving storms, might create ocean currents; and I afterwards learned that Mr. David Milne had previously announced the same view. I shall repeat here the passage in which my opinion is stated.

If a revolving power, like a whirlwind, were the only one exerted, it might be expected that the level of the water would be diminished at the centre of the vortex, though heaped up towards the verge of the storm. But it may be possible, that a wave of a round or oval form, moving onward like a tidal wave, but at the rate of the storm's progress, may accompany the storm in its course, and that its height may depend on the degree of diminished atmospheric pressure, modified by the revolving power of the wind. The impulse in the direction of the storm's course being given, and maintained for a few hundred miles, currents, very similar to the ordinary currents of the tidal wave, might be created: so that, if the effect produced by such a wave is added to a spring-tide, it might assist in causing those inundations in flat lands which often occur in violent storms. It will, therefore, be very desirable to note the height to which the tides rise on the leeward side of islands, particularly those lying at a distance from and uninfluenced by continents.

After the Bermuda storm of Sept. 1839, Mr. Hurst,

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commander of the brigantine Queen Victoria, found the current of the Gulf-stream neutralized: and the same commander, on another occasion, found the current running to the westward; a fact corroborated by other printed statements at the time.

The storm of 1839, when crossing the Gulf-stream, was probably five hundred miles in diameter; and a diminished pressure, amounting to a fifteenth part of the atmosphere, at the centre of a moving circle of this extent, seems adequate either to arrest or to accelerate existing currents, or to create new ones.

The width of the Bay of Bengal, contracting gradually, does not much exceed half the circumference of the greatest storms on the twentieth degree of north latitude, so that an attendant wave, during a great hurricane coming from the south, might be expected to deluge the low countries at the mouths of the Ganges.

This part of the subject deserves the attention of engineers, whilst constructing breakwaters in the sea.

In a paper communicated to the Royal Society of Edinburgh by Mr. Milne, and published in their Transactions for 1839; he describes two whirlwind storms which passed over the British Islands, and he thus speaks of the storm-wave.

"The effects of this gale on the waters of the Atlantic caused an unusually high tide in almost all the parts in the Irish and English Channels. I find that on Wednesday night, the 28th November, 1838, Newry, a town to the north of Dublin, was inundated by the highest tide remembered. It was also a remarkably high tide at Strangford and at Donaghadee. On the same night, at Swansea the tide rose seven feet

two inches above its proper level. At Milford the tide rose higher than it had ever been seen before. At Plymouth the tide rose over the quays, an occurrence said to be unprecedented. On the Thursday forenoon the tide rose in the Thames, at Greenock, Oban, Tobermory, and in Orkney, above the level of the quays. At Oban and Tobermory, though these places are completely land-locked, and exposed to no swell from the ocean, all loose materials lying on the quays were swept off by the mere rise of the tidal waters. The height of the tide was there the more remarkable, as it was the season not of spring, but of neap tide. That this extraordinary elevation of the sea was occasioned by the suddenly diminished pressure of the atmosphere there is no doubt. The effect of this diminished pressure must have been to elevate the surface of the ocean, and produce a sudden accumulation of waters—a species of wave. The accumulation would take place along the line of diminished pressure, or, in other words, in the direction of the storm. This storm-wave (for such it may not improperly be termed) moved therefore through the Atlantic in a N.N.E. direction, and happening to impinge on Great Britain and Ireland, about the time of high water, caused the waters to overflow. That this wave had been produced, not in the British seas, but a great distance in the Atlantic, is evident from this, that it preceded by several hours the arrival of the most violent part of the hurricane, and even the lowest depression of the barometer. Any undulation in the waters of the ocean, it is well known, is very rapidly propagated."

When I heard of the occurrence of the Coringa Hurricane, and how the sea had overwhelmed a town and villages, with their inhabitants, I drew the at-

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tention of Mr. Piddington to the idea I entertained of the existence of a storm wave. He has since devoted much attention to the subject, and his observations tend to confirm the idea, that ocean currents are created by diminished atmospheric pressure during progressive storms. In the case of the Coringa Hurricane, the storm-wave probably combined its influence with the easterly wind, on the northern side of the whirlwind, which set the sea against the shore. The waters of the River Godavery became arrested in their course. These combined causes created a deluge.

I subjoin some extracts from the published reports. From these reports it appears, that the true whirlwind storm set in at Coringa, with the wind north-easterly, at 10 P.M. on the 16th; the north-westerly wind which preceded the storm, not being a part of the whirlwind, although probably caused by its approach.

"*Observations of* GEORGE A. SMITH, ESQ., *Collector of the District of Rajamundry, on the Storm of the* 16*th November*, 1839.

Coringa. "On the night of the 16th instant, this district was visited by a most awful storm, attended by an inundation of the sea, which has destroyed many villages on the coast, and caused a very heavy loss of life, I fear at least to an extent of 5000, including those from the number of vessels wrecked.

"According to my own observation, the storm commenced about 10 P.M. of the 16th, and blew from the north-east. It afterwards veered round to the eastward, from which point it blew strongest, and after lasting six hours, ceased about 4 o'clock in the morning of the 17th, the wind having got round to the southward."

In another part, the same gentlemen says,

"It has been observed to me, that though the inundation of the sea was attributable to the east wind (and had that continued

a short time longer the consequences would have been still more disastrous); yet that the wind was actually stronger, and more damage was done to houses, &c., after it had shifted to the south-east."

From the MADRAS HERALD, *27th November*, 1839.

Coringa.

"We were visited on the night of the 16th instant by the most terrible gale of wind possible. Your house at Ingeram is completely unroofed, the trees and walls of the compound destroyed, and P—— was very nearly drowned. All the European and native houses are uninhabitable, and there is nothing to be seen, from Coringa to this place, but a heap of ruins.

"The wind began to blow in the afternoon of the 16th, but was moderate till about 11 o'clock at night, when it became furious, and lasted till 4 next morning.

"The water from the sea rushed in with such violence, that the only houses remaining at Coringa are ——'s large house, and three or four other brick-built houses. All the rest, it is said, have been carried away. I have had 2½ feet of sea water in my garden, and in my room which is under my bungalow 1½ foot.

"It is said that more than 20,000 people have perished by this terrible hurricane, which lasted only five or six hours. There is nothing to be seen in every direction, but dead bodies and drowned cattle. Sixty native vessels which were in the roads, laden with paddy, have disappeared, and it is not known what is become of them.* * * All over the country was nothing but like the sea. You can have an idea of it, when I tell you that I see from my house a Choolia sloop, lying quite near to the white pagoda of Onagalo, which is four or five miles from Coringa, in the interior of the land."

"*Observations of* MR. PASCOL, *Superintendent of the Light House on Hope Island, off Coringa.*

"On Saturday, about 8 A.M., *16th November*, 1839, it commenced blowing fresh from the north-eastward, and continued so till 1 P.M., when the wind shifted round to N.N.W. and terminated in a gale. At 2 P.M. the wind shifted to N.W., and the river commenced rising; and at 8 P.M. the island was under water. At 10 P.M. the wind hauled round to the N.E., and blew

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a dreadful hurricane, during which time the water rose to about two feet in the lighthouse, with a heavy confused sea beating about it, which burst open the door and swept away every article in it. At this time the lantern wrenched and whirled itself aloft. The conductor broke into five pieces, and my house was completely washed away, with every article it contained. At 12 A.M. (midnight) the wind shifted to the eastward, and at 1 A.M. on the 17th (Sunday), it shifted to the south-eastward, and blew tremendously strong. At 2 A.M. the water began to recede. At daybreak, the weather cleared up, and we found five corpses in the island."

This storm took place during the season of the N.E. monsoon. By inspecting the annexed diagram, it will be seen, that its course was across that of the monsoon. Whilst the centre of the storm was in latitude 13°, it was moving about W.N.W., which is the direction in which the Barbados hurricanes, in the same latitude, generally move. Like the West India hurricanes, as it proceeded, its track became more northerly.

Inland.

The character of this storm appears to have been altered after it came in contact with the high land of India; and there is no account from inland, that any great storm existed. The barometers belonging to the surveying department at Ryacottah, fell for some time before the hurricane, and rose some time after it.

The circles in the figure are confined to the space where the storm was most violent. But its influence was felt as far as the northern part of the Bay of Bengal.

Helen.

The commander of the Helen, having spoke a pilot brig on the 15th, was advised to stand to sea, the weather with her, also, having a very threatening appearance, and the wind increasing fast. On the 16th, the commander of the Helen, having worn his ship, and stood to the N.N.E., a pilot brig again signalled to him to stand to sea, having, at the time, fresh gales and heavy squalls from the eastward.

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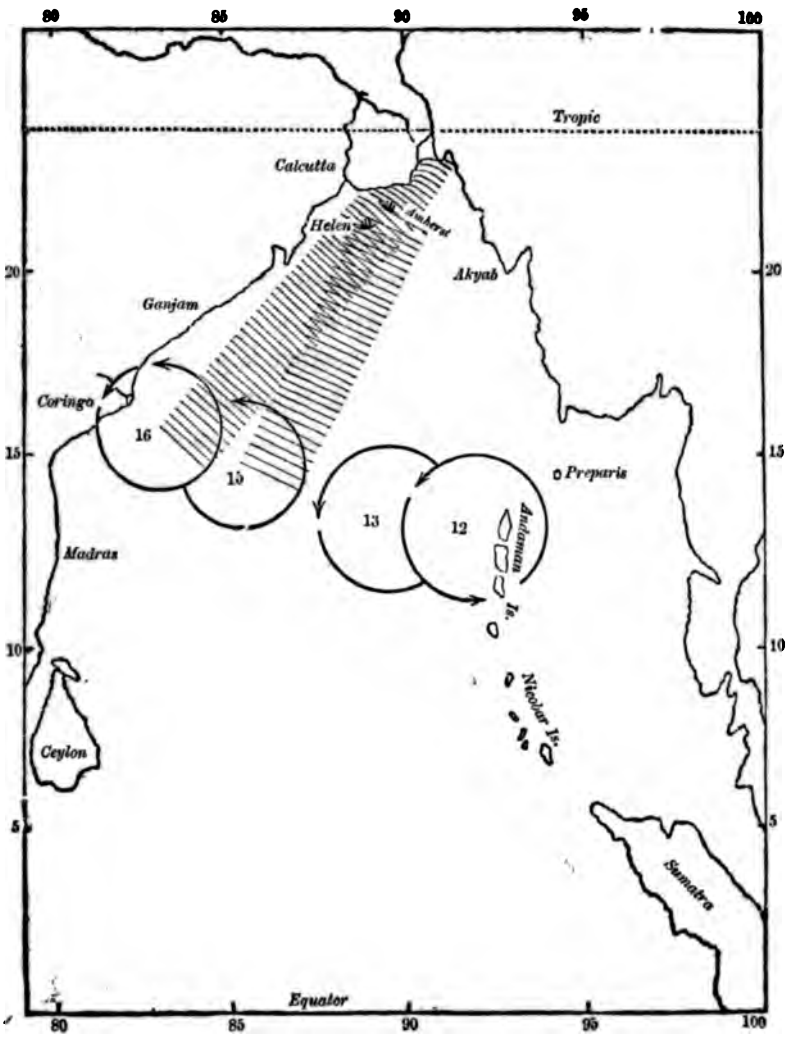
Swell.

Two steamers, the Amherst and the Enterprize, were crossing the head of the bay from Akyab to the Hoogley, and experienced the swell from the Coringa Hurricane. Captain West, the commander of the Enterprize, says, "We left Akyab on the 16th, and had a heavy swell from the S.W. and S.S.W., and as we got over to the westward, it was rather squally, but not of the least consequence."



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A published extract from the log of the Amherst, states, "That at midnight on the 15th, they had fresh breezes and cloudy weather, with a heavy swell from the S.S.W. On the 16th at midnight, the appearance was threatening to the westward, with strong breezes and rain, and the wind at N.E." At noon on the 16th, the Amherst's log-book states, "Very threatening appearance to E.S.E. Wind east and moderate, lumbering swell from E.S.E., and cross swell all ways." At midnight it is again recorded, as "threatening to the south-westward."

The Master Attendant at Chittagong, states, "That on the 14th, 15th, and 16th of November, there was no gale there, but that they had very cloudy weather, with slight rain, with the wind variable from N.N.E. to S.E., but nothing approaching to a gale, although there was a *heavy sea outside*."

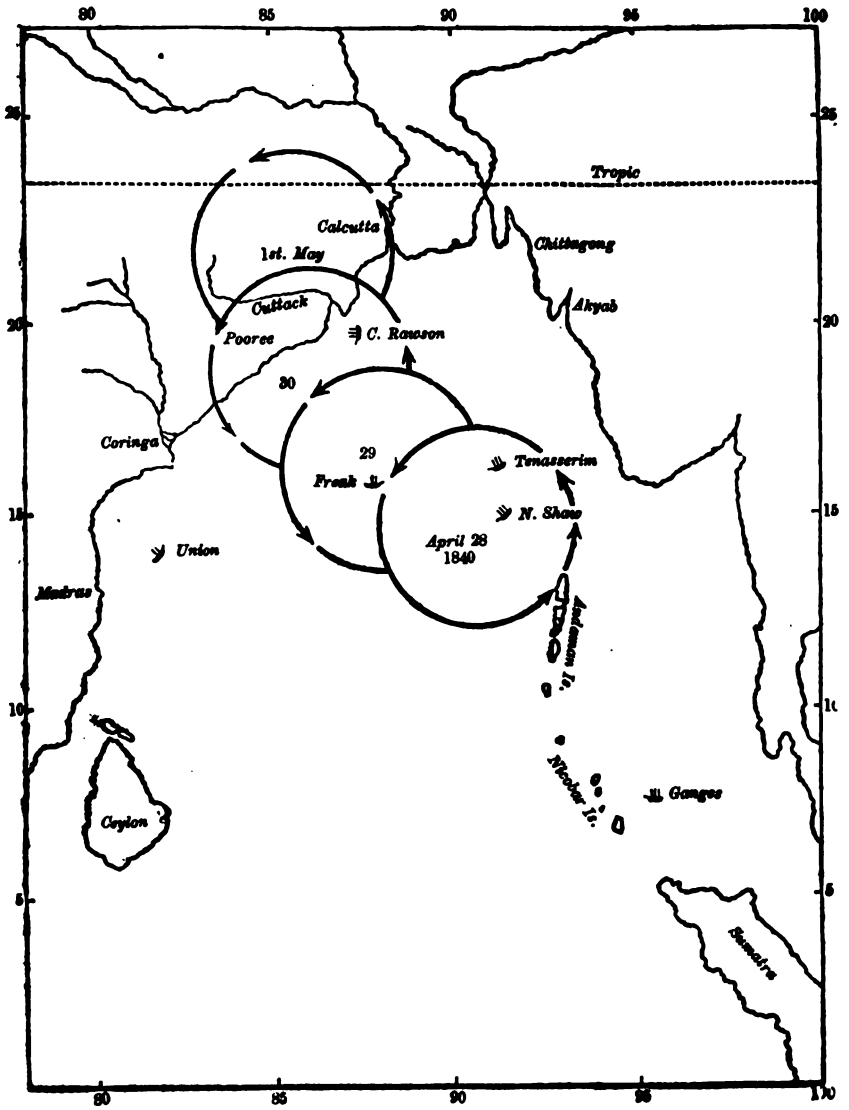
In the register of the weather kept in the surveying brig Hateras at Chittagong, it is noted, that there was a heavy swell of the sea from the southward, during the 14th, 15th, 16th, and 17th, which subsided on the 18th.

An inspection of the above figure will show how a swell raised by the Coringa Hurricane, and rolling on in the direction of tangents to the circles of the whirlwind would raise a high and cross sea at the head of the Bay of Bengal.

The Cuttack Hurricane, from the 28th April to 1st May, 1840.

The next diagram represents another hurricane in the Bay of Bengal, traced from the Andaman Islands

to the shores of India, on a somewhat more northerly progression than the Coringa Hurricane. It serves to explain the danger ships at the head of the Bay of Bengal are exposed to, when a whirlwind storm is passing over it.



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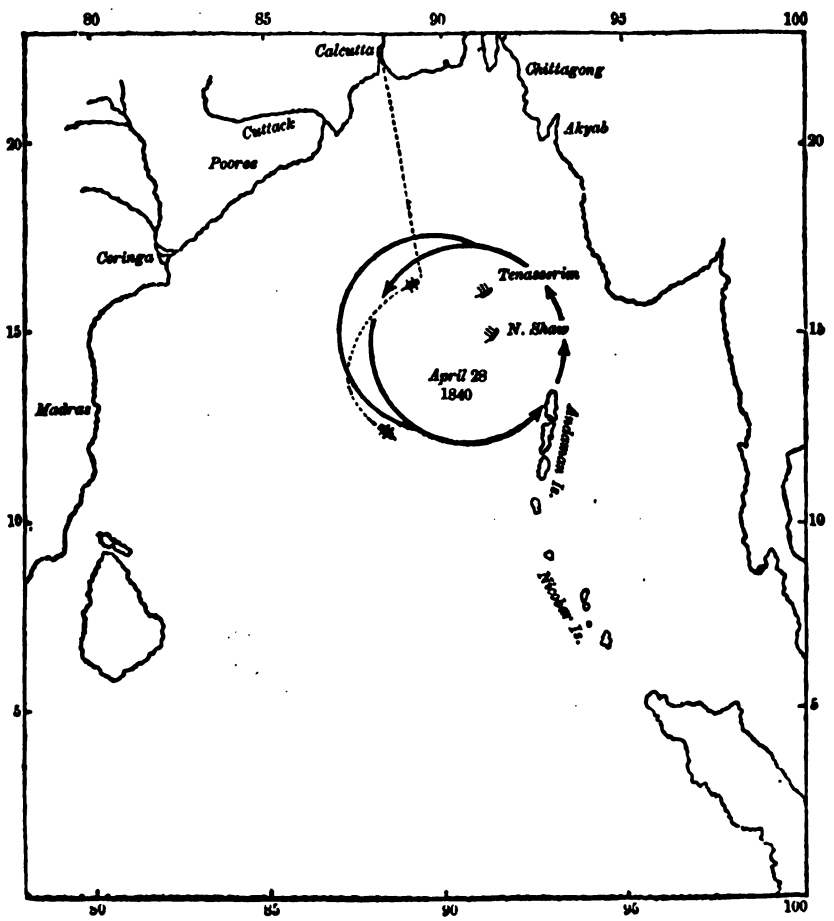
These gales generally embrace the whole head of the bay, and, being whirlwinds, make each coast a lee shore. If an accumulation of water accompanies the storm in the form of a storm-wave, unusual currents will be created at the time. The position of ships in the northern half of such whirlwinds, must always be one of deep interest, and often of great danger. I hope it will be of service to navigators, who may hereafter be placed in this situation, to reprint here the narratives of the commanders of ships who have been in this trying position.

The track of the Cuttack storm has been laid down from thirty log-books, or reports of different kinds, obtained and printed in the "Asiatic Journal," by Mr. Piddington. As in the previous diagrams, the figures in the centres of the circles, denote the daily progress of the storm.

Ships sailing from Calcutta for the southward, when gales are crossing the head of the Bay of Bengal, will generally be on the port-tack, from the circumstance of their having the wind at east in the northern half of the gale. By standing on this course, they get deeper into the gale, and they are often forced at last to shorten sail, and have their course arrested at the place of greatest danger. This happened to the Nusserath Shaw, a ship conveying troops from Calcutta to Singapore. Her place will be found marked in the small chart prefixed. She met the Cuttack gale on the 27th of April, in that part of it in which the wind blew E.N.E., as it was coming from the direction of the Gulf of Siam. From the account of what happened to her, she appears to have stood on so as to meet the middle of the storm, where she received so much

damage, that she returned to Calcutta. This might have been avoided had the Nusserath Shaw been sailed towards the north-east, or brought to the wind on the starboard tack, a course which should always be adopted when ships from Calcutta sailing southward cannot with safety cross the front of a storm. Whenever they can with safety cross the front of an approaching whirlwind storm, they procure a fair wind, veering from north-east to north and north-west. But, by standing due south, they would probably, under the



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supposed circumstances, have a high sea on the larboard or port beam, which would cause them to roll very heavily. It might, therefore, be found preferable to sail on a curve, as in the last figure, being guided by the changes of the wind and the swell.

"*Extract from the Log of the Ship* NUSSERATH SHAW, *Captain* EDWARDS, *bound from Calcutta to Singapore and China, with troops on board, reduced to Civil Time.*

Nusserath Shaw.

"*27th April*, 1840.—At midnight, light airs, and fine, hot, sultry weather; wind S.E. and S. At 4 A.M. E. by N. At 8 increasing, and at noon frequent hard squalls. Lat. Obs. 16°. 2′ E. P.M. Strong breezes E.N.E. to midnight, with dark, cloudy weather, and increasing sea.

"*28th April.*—Wind E.N.E. to noon. 7 A.M. Lost main-topsail. 9 A.M. Increasing gale; lost fore and main-top gallant-mast, and head of main-topmast. 10, gale increasing; lost mizenmast, boats, &c. At 11, heavy, white squall. Noon, blowing a perfect hurricane; three guns lost overboard; no one able to go aloft. From 7 A.M. lying-to under bare poles, with wind to the S.E. Noon, Lat. Account, 14°. 26′. 23″ N., Long. 91°. 34′ E. P.M. Blowing a hurricane; all the hatches battened down; wind E.N.E. At 3 P.M. it shifted suddenly round to Centre. S.W., laying the vessel gunnel under, with sea awfully high. Midnight, the same, and frequent squalls; vessel a perfect wreck, with all the braces, &c., gone.

"*29th April.*—From midnight lying-to. 1 A.M. Wind S.S.W. Noon, squally and rain. Lat. Obs. 15°. 23′ N., Long. 90°. 31′ E. Wind S. by W. P.M. Fresh gales and heavy weather, with dreadful heavy gusts of wind and squalls; sea breaking over the ship; 3½ feet water in the hold. At 8, weather as before. Midnight, less wind and sea, but ship labouring dreadfully; lying-to throughout, with wind from the westward.

"*30th April.*—1 A.M. Ship rolling dreadfully; still lying-to. At 4, very squally and fresh gales, with dark cloudy weather. Noon, Lat. 15°.31′ N., Long. 90°. 11′ E. P.M. Fresh gales, with a heavy cross sea; wind S.E.; bore up for Calcutta."

Tenasserim.

The bark Tenasserim, bound from Calcutta to Rangoon, was on the 27th April in latitude 17°. 40′,

and had the wind first strong from the eastward. Like the Nusserath Shaw, she continued for a considerable time to sail southward, getting deep into the whirlwind storm. The extract from the log will show how, when this vessel wore, with her head to the north-east, the wind with her moderated, so that she could carry a reefed foresail.

The extract from this log-book is further interesting, inasmuch as it describes another instance of a whirlpillar occurring in the midst of a great storm.

"*Extract from the Barque* TENASSERIM'S *Log-book, by Captain* TAPLEY, *bound from Calcutta to Rangoon, reduced to Civil Time.*

"27*th April,* 1840.—First part, light variable winds from the S.S.E., and suddenly shifting E.N.E. Midnight, calm, sea smooth. Last part of this day, strong fresh breeze eastward; smooth water. Long. Chron. noon, 91°.50′ E., Lat. Obs. 17°.40′ N. Noon this day, cloudy, wind from the eastward, about a seven and eight knot breeze. 1 P.M. Strong breezes eastward, cloudy sky, and unsettled weather. Sunset, strong breezes and cloudy, with a threatening appearance to the eastward. At 8, made the ship snug. Midnight, strong breezes from E. by S.½S., with a very threatening appearance; breeze gradually increasing, and coming in strong gusts and squalls.

"28*th April.*—Weather more threatening, and a heavy sea getting up from the eastward. Daylight, wind S.E., having every appearance of a gale, and blowing very hard; made all snug for bad weather. At 8, blowing a severe gale, sea at this time tremendous; battened a double tarpaulin fore and aft, sea making a continual breach over the ship, and blowing very hard. Noon, heavy gale, ship labouring much; was obliged to keep the close-reefed topsail on her, owing to the heavy weather lurches; sea making a continued roll over the vessel; gale increasing; sun obscured. During the whole of this 24 hours ship was sailing to the southward. P.M. Heavy gale from S.E. and varying to S.S.E., with a terrific sea on, making an awful breach over the ship; going 2½ knots through the water. Up to 4 A.M. course S. by W. to S.W. From 4 A.M. to noon, ship's head to N.E.

Sailing towards storm's centre.

Wore.

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and E.N.E., having wore round; carried away one of the channel-plates. Midnight, ship rolling heavily, taking the sea in on both sides.

"*29th April.*—4 A.M. Wind little more moderate, but sea still continuing the same; set reef foresail to steady the ship. Noon, rather clear, but gale still blowing hard, wind S.E. Noon, Lat. by Obs. 16°.32′ N., Long. Obs. noon, 91°.02′ E. At 9, a brig passed, scudding under a foresail only, with topgallant-mast on deck. 1 P.M. Up foresail, a very threatening appearance to the southward. At 2.30, wore ship to the S.W., at the same time to clear a whirlwind; by this manœuvre allowed the whirlwind to pass about 200 yards on the lee-quarter; at this time blowing a perfect hurricane, wind S.S.E. and S.; furled every thing to a storm main-trysail, and hove the ship to; torrents of rain, sea making a constant breach over the ship. At 5 P.M. more moderate; set the close-reefed topsails; and at 10.30, wore ship to the E.S.E.; sea still continued high, and a cross head sea, owing to shift of wind in the whirlwind.

Whirlpillar.

"*30th April.*—Daylight, more moderate; wind S.S.E., wore round to the S.W., sea still running high, and confused. A.M. Weather clearing up a little. Noon, Obs. Lat. 16°.21′ N., Long. 91°. 50′ E. Moderate."

Mr. Piddington having requested some further explanation relative to the whirlpillar, the following is the answer he received from Captain Tapley:—

"At 1 P.M., on the 29th April, a very threatening appearance to the southward; ship's head E. A terrific squall from the S.S.E., rising very rapidly, and having a very blowing appearance. When the squall was within two miles of the ship, perceived a heaving whirlwind flying to the N.N.W.; immediately wore the ship to the S.W., or first to the westward, to give the ship way through the water. By doing so, allowed the whirlwind to pass the ship; when passed, brought the ship to the wind. Clued up every thing and furled all. Soon after, about 10 minutes, the squall took the ship from the S.S.E. Ship's head about S.W., blowing a complete hurricane; could not see half the length of the vessel on the water, owing to the tops of the sea being blown by the force of the wind, and a deluge of rain at the same time. I cannot remember how it was turning, as we were anxious to

turn out of it. It was going round at a furious rate, and disappeared in the rain, to the N.N.W. I do not recollect any lightning at the time; we could not discern it until it had approached pretty close, and then the most we saw was the foaming of the water, travelling up at a rapid progress. The day had been fine, and a little clear for a few hours, but blowing hard. At the time this squall appeared, the sky all round assumed a threatening appearance, and squalls gathered and rose rapidly. After this severe squall the weather kept bad during the remainder of the 24 hours."

Changes in the swell.

It was remarked at page 42, that near the centre of a revolving storm, the wind seems to veer round faster than the waves change their direction: but on the outer part of such storm, it would seem as if the change of direction of the swell precedes the changes of the wind.

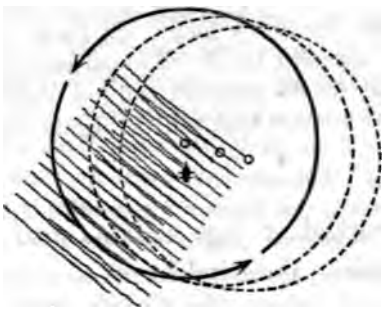
Freak.

What befell the brig Freak, on her voyage from Calcutta to Singapore, will serve to illustrate this. This vessel left the Sand Heads on the 19th of April, 1840, but meeting with light and baffling southerly winds, she was detained until the 27th, at the upper part of the Bay of Bengal. On the 27th, the wind became easterly, no doubt owing to the coming storm. That night she carried studding-sails. The gale's centre for the 28th, is marked on the small chart. Page 109. From that period, the narrative in the log-book assumes the deepest interest, and is printed here. It appears from it, that the Freak ran across the front of the storm's track, and in doing so she went very near the centre.

The annexed figure is intended to show the progression of the gale with reference to the position of the Freak.

The dotted circles are meant to show the gale moving forward, and the dark circle the storm at the moment

CHAP. VI. that the wind became west, when the Freak broached-to, with her head to the north.



The undulations coming from the easternmost of the three circles, will serve to explain why that ship was in the trough of the sea, when her head was south-east by east; and she would present her starboard bow to the same undulations, when she broached-to, with her head to the north. But it is very probable that a new swell from the north would arise, not long after the veering of the wind, so that she would have both swells and a cross sea.

The Freak may be supposed to have been in the position marked in the next figure; and at that time the barometer had fallen 2·05 inches from the beginning of the gale. It is very desirable that seamen, who become involved in the vortex of violent storms, should publish such observations as the circumstances will allow them to make, on the time when the swell changes, when compared to the veering of the wind. It is only through the means of such observations made public, that, step by step, we can acquire a complete knowledge of the nature of the tempest.

Page 118.

"*Extract from the Log of the Brig* FREAK, *from Calcutta to Singapore, communicated by Captain* SMOULT, *reduced to Civil Time.*

"19*th April*, 1840.—Left the pilot at the Sand Heads, and carried the wind about S.S.W., standing to S.E; the wind then became light, and veered from S.S.E. to S.W. The weather continued light and variable, with flashes of lightning in the north after sunset. On the 20th, Lat. 20°.31′ N., Long. 88°.35′ E. On the 26th, Lat. 19°.23′ N., Long .88°.40′ E., light winds between S.W. and S., *with strong northerly currents*, until the 27th, when the wind hauled round to the east. Lat. 18°.56′ N., Long. 88°.30′ E. P.M. Moderate breeze with fine clear weather. At 8, the wind increased, and weather became cloudy and threatening, which obliged us to take in all steering-sails. The wind moderated at midnight. Set the steering-sails.

Fig. page 109.

Storm current.

"28*th April*.—At 10 A.M. the wind freshened again, took in all steering-sails and royals; the barometer standing about 29·30 steady. Lat. 17°.40′ N., Long. 88°.32′ E. P.M. Strong breeze and threatening weather; the barometer vibrating very much. Dark heavy clouds rising in the north, and wearing the appearance of ragged edges.

"Commenced making preparations for a gale of wind, by sending down the lofty yards, and securing spars, hatchways, boats, &c., and double gasketing the sails as we furled them. At 6 P.M. we had got every sail stowed, except the close-reefed fore-topsail, the gale increasing so rapidly from N.N.E. that it obliged us to stow the main-topsail, without reefing; the sea rising in proportion. The wind gradually veered round to the north, and blew from that quarter till midnight (Lat. Account 15°.46′ N., Long. 88°.18′ E.), when the wind chopped round to the N.W. suddenly, and blew with double force, which threw the ship on her broadside; the helm was immediately placed a-weather, but was rendered useless, owing to the position of the ship. She lay dormant for some time, the tempest roaring with great fury, and sea flying over us in foam; the lightning mingling gave it the appearance of fire and water. The roaring of the wind prevented us distinguishing whether it thundered or not. We were soon enabled to brace the foreyard forward, which *in the trough of the sea* wore her before the wind, heading per compass, S.E. by E. directly in the trough of a tremendous sea, knocked up by the wind from north, which rendered our position most dangerous, as every sea appeared coming on board. In a short time she broached-to, with her

Wind north, chopping to north-west.

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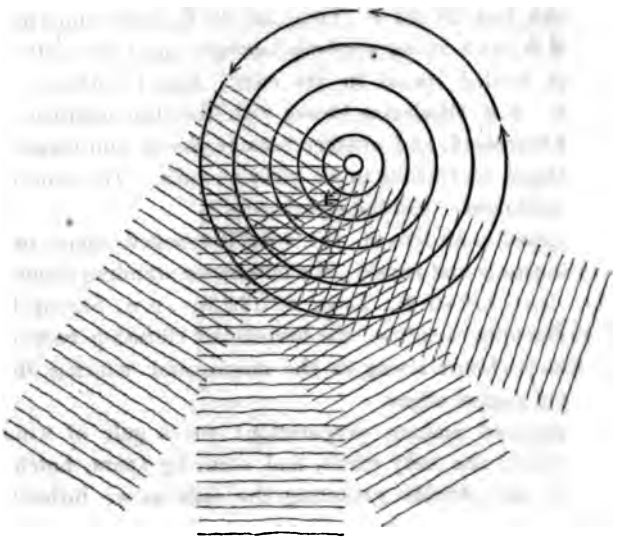
head north. The wind veering to the westward, and blowing with great fury, the ship was again thrown on her side, but being head to sea lay much easier (the barometer sunk to 27·25 in the gale); the foam flying so thick, as to extinguish every object except at intervals. A supposed break in the sky, afterwards proved to be the top of the sea.



"29*th April*.—About one in the morning a sudden and awful gust of wind carried away the foremast; it was accompanied by a vivid flash of lightning, which enabled us to see the mast and yards carried up into the air as if in a whirlwind, and then fall on deck with such violence that the foreyard-arm stove in the fore-hatchway, and went chock over into the weather wing of the ship, leaving the other arm extended to leeward. To this the wreck of the masts and other yards were attached acting as a lever on the ship keeping her side down. It remained thus the rest of the night, in spite of all our endeavours to cut and clear it away from the ship. The furled sails blew away by piecemeal. The quarter-boat filled with water and broke away, heavy seas breaking on board, and the darkness so intense that we could not see a yard before us; the water rushing down the hatchways, against all precaution, carried away the larboard bulwark and several staunchions, did the roundhouse much injury, and also

everything in its way. We found much difficulty in getting the crew to the pumps. Found a great quantity of water in the hold. Considered it prudent to throw over some of the cargo, in order to lighten the ship, as the water poured down the fore-hatchway in great quantities. The wreck of the masts aft beating about in a most fearful manner, endangering the mainmast, the only spar we had to work with, in running down to the Sand Heads. At daylight, wind S.W., the crew kept constantly at the pumps. The barometer rising very slowly, being at 27·30. Noon, sun obscure. Lat. Account 16°.2′ N., Long. 88°.36′ E. P.M Wind S.W. still blowing furiously, and ship labouring heavily. Shipping water over all. Showers of rain at intervals, hands kept constantly at the pumps, and clearing away the wreck. The same weather throughout. Wind S.W.

"30*th April*.—At daylight loosed the peak of the mainsail, hoisted it up a few feet, and hoisted the fore-topmast staysail to the throat halliards, in order to keep her to the wind: this soon blew away, together with the spare jib, which was hoisted to the mainstay. Constantly employed pumping. Noon, a little more moderate. Lat. Account 16°.41′ N., Long. 88°.0′ E. Cut away the wreck from the jib-boom, which was sprung; bent a spare foresail to the main-yard and set it. Got a preventer main-top-mast-stay up, and otherwise repaired damages. Bore up for Calcutta. Bore up.

"1*st May*.—Midnight, squally with rain and thick cloudy weather; at daylight, people employed setting up rigging, and getting up a main-topsail. Noon, moderate breeze with passing clouds. Lat. Obs. 17°.26′ N., Long. 87°.47′ E.; barometer 28·30.

"4*th May*.—At 4 P.M. got a pilot. During this gale and previously to it, the following phenomena were manifested. The clouds rose rapidly in the north, appearing ragged and black with white feathery edges, and stretching to the southward in long tails. The sea became tumultuous; and as soon as the gale reached us, the atmosphere became very sultry. The barometer stood at noon, about 29·30, the standard height previous to the gale, and now in Calcutta about 29·20."

The Christopher Rawson came from the southward, and passed across the front of the hurricane's track, before the approach of the storm: but by the time she had Christopher Rawson.

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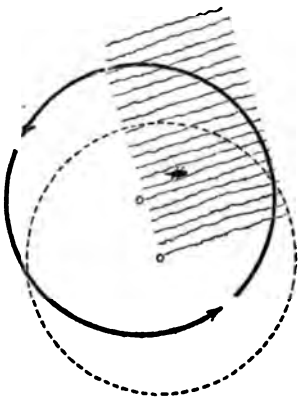
made the outer floating light, the sea proceeding from the hurricane had become too high for her to receive a pilot, which caused her to close-reef topsails and courses and stand to the south, with the wind and sea both from the east and on the port-beam. Sailing south the Christopher Rawson was returning towards the same storm, ahead of which she had just crossed. With this ship the wind veered by the E.S.E., the S.E., the S.S.E., the S.S.W., and the S.W., which changes of wind are explained by her position at the time with reference to the storm's centre, together with its curving to the north on the 30th of April and 1st of May.

Fig. page 109.

When the wind had veered to the S.S.E. the ship's head was S.W. by W. She must therefore have been at that time on the port-tack, drawing towards the hurricane's centre. In the log-book she is described as under bare poles *lying in the trough of the sea.* Being in the storm's right-hand semicircle she would have the swell from the southward, and contrariwise to the ship Freak when in the left-hand semicircle, as in this figure.



An extract from the Log of the Christopher Rawson is printed below.

Storm current.

Whilst examining the log-books of ships in the Bay of Bengal, I have frequently found that when their commanders supposed themselves to be in the middle of the Bay, they were actually drifting on the shore of India. The following narrative relating to the ship Christopher Rawson, affords an instance of this.

"*Abstract of the Log of the Ship* CHRISTOPHER RAWSON, *Captain* SMELLIE, *reduced to Civil Time.*

"27*th April.*—Exchanged numbers with the Marion, Captain Pope, in Lat. 17°. 15′. 30″ N.; Bar. 29·80. The barometer down four lines, and the weather very oppressive; light S.S.E. winds and sultry; barometer falling fast.

"28*th April.*—Midnight, heavy gathering clouds in the S.E. and threatening look. At 10, a very heavy squall from east: I consider this the commencement of the gale, the scud flying in confused masses, and a number of Sand birds in the rigging. At noon, heavy appearance of weather. Lat. Obs. 19°.29′.15″; Bar. 29·40; blowing fresh from E. and E.S.E.; the Bar. 29·35, and every appearance of worse weather; making a bold push for the pilot. Midnight and until daydawn, constant heavy squalls, and much heavy rain.

"29*th April.*—At 4 A.M. sounded in 17 fathoms. At 5, sounded in 10 fathoms, and by two excellent chronometers, made the floating light bear from us due west, 15 miles distant. Finding the sea too high to receive a pilot, close-reefed the topsails and courses: under this sail stood out south; wind a-beam at east, gale increasing, and the sea rising fast. At 10 A.M. a tremendous sea spread from the S.S.W. and a heavy ground-swell on our beam east; preparing for bad weather. At noon, gale very heavy; no sun; suppose ourselves S.W. from the floating light, distant 30 miles; gale increasing at E.S.E. and E. in the heavy squalls; a very high confused sea, often breaking over all. At midnight, sprung foreyard; sounded in 30 fathoms.

"30*th April.*—2 A.M. Blowing a hurricane; sprung our main-mast in the deck partners; the sea washing away our large cutter, davits and all, and making a clear breach over all; both

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pumps going; the wind S.E. and veering round gradually to the southward. At daydawn, observed some broken spars and short pieces of plank passing us; shipped a heavy sea, and broke the lashings of the skylight, which unshipped, and nearly filled our cabin with water. Noon, Lat. Obs. 20°. 28′ N. A heavy sea struck the ship aft, and injured our rudder-head. Bar. 28·80.

Fig. page 120.

" Bar. 28·90. Gale continues heavy; ship under bare poles, lying in the trough of the sea, very uneasy; wind S.S.E., ship's head S.W. by W.; having blown our storm-sails away, got a bolt of new canvas in the mizen rigging.

" 1*st May*.—At daydawn, ship on her beam ends, and the sea making a fair breach over all; the water much discoloured; sounded in 16 fathoms on the edge of Point Palmiras reef, the wind suddenly shifting into the S. S.W., wore ship to the S. E.; sun obscured at noon; no vessels in sight.

" Some attempts at a clear up; ship lying helpless in the trough of the sea; barometer rose four lines. At 2 P.M. set the close-reefed topsails. Sunset, clear weather, but destructive sea. Midnight, heavy squalls from S.W.

Storm current.

" 2*nd May*.—Daydawn, moderating fast; out reefs, and stood to the W.N.W. At 7, sighted a pilot vessel. At 8.30, obtained a pilot. From our position at the commencement of the gale, I supposed myself in the centre of the Bay during the worst part of it, and allowed 36 hours' drift under bare poles before I looked for shoal water. My astonishment was great at finding the ship, early on the 1st, in 16 fathoms on the reef: and I can only account for it, by supposing the easterly gale had caused a current, or set to the westward, of at least four miles per hour, which may perhaps account for so many vessels getting over the Point, as I had the advantage of 15 miles east at its commencement."

Calcutta.

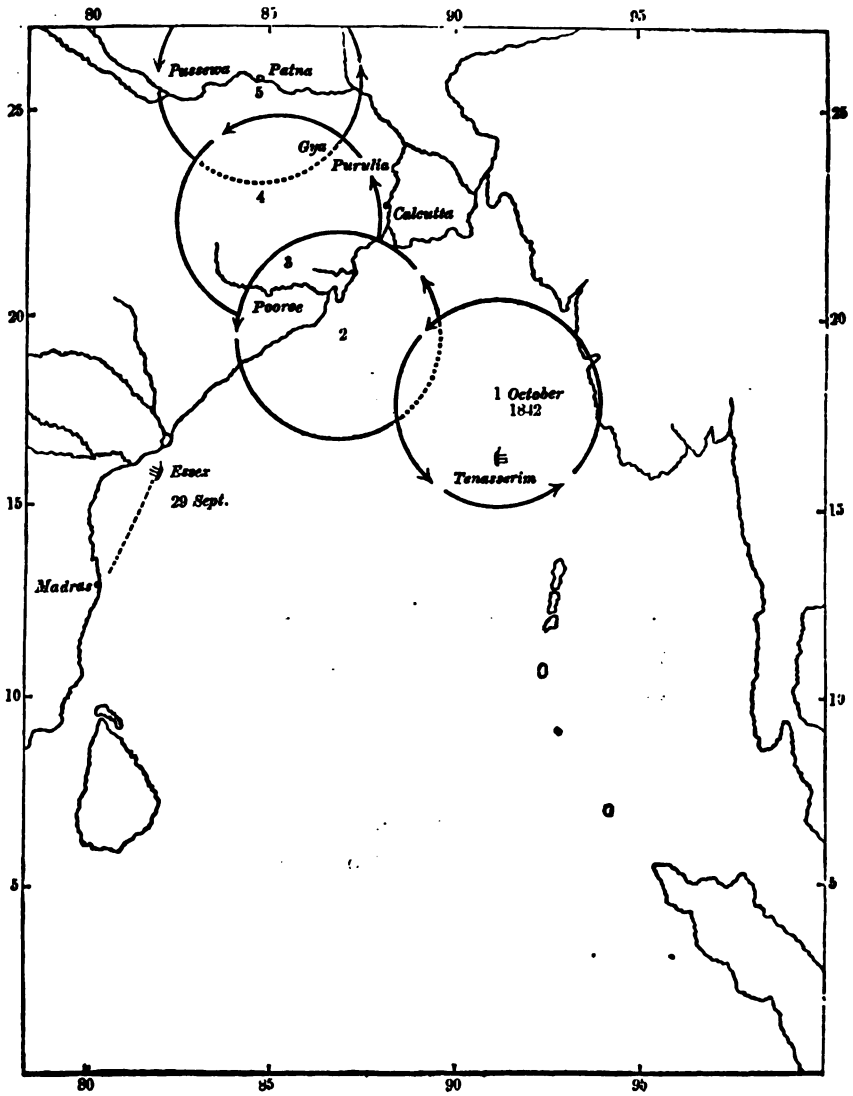
For Calcutta we have the observations on the weather made by Mr. Piddington.

The Barometer on the 29th had fallen to ..... 29·74
At noon on the 30th it was ..... 29·64
At 4. 30 P.M. „ it was ..... 29·57
and during these two days, the wind had been E. and E.N.E.
On the 1st May the wind veered from E. to E.S.E.
At 6 A.M. the Barometer had fallen to ..... 29·52

At 10.30 scud flying fast from S.E., and a squall with rain from that quarter ..... Bar. 29·52
Noon ..... 29·47
At 3 P.M. a gale, with heavy squalls from S.E. and E.S.E. ..... Bar. 29·39
Gale in heavy squalls from E.S.E.
At 4. 15 P.M. wind south, a gale .... 29·39
5. 30 P.M. do. .... 29·40
6. 30 P.M. wind S. by W.; heavy dark scud and squalls ..... Bar. 29·42
7. 30 P.M. sudden squalls and lulls between them from S. S.W. and S.W. ..... Bar. 29·45
9 P.M. sudden squalls, hauling-to S.W. .... 29·52
2nd May, 5 A.M. fine weather .... 29·58

The Pooree Storm, 2nd October, 1842.

The danger to which ships are exposed on the coasts of Bengal and Cuttack by storms crossing the head of the Bay of Bengal, was strongly exemplified by what happened to some of the vessels which encountered the gale of the 2nd of October, 1842. The next diagram, represents the track which that storm seems to have followed. I shall place first in order, the account of it which Mr. Piddington received from Pooree, where this storm first touched the shore of India. Next will follow an abridged extract from the log-book of the Honourable East India Company's ship Tenasserim. This vessel, coming from the southward, hove-to, until the centre of the storm passed by. She was then enabled, as will be seen by the abridged log, to convert the eastern side of the gale into a fair wind for her voyage to Calcutta, experiencing comparatively moderate weather. When off the mouth of the Hoogley, at 6. 30 A.M., on the 2nd of October, she had a heavy southerly sea.



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The accounts of what befell the ships leaving the Hoogley, and which sailed into the storm on its north-western side, will follow. These narratives are practical examples of the deepest interest to seamen.

Account of the storm at Pooree, addressed to Mr. Piddington, by the Civil Surgeon at that Station.

Pooree.

"We have lately had a very severe gale at Pooree, the particulars of which I subjoin. The gale commenced on the night of the 1st inst., blowing hard from the north, with rain. It continued to increase during the 2nd, occasionally blowing in very hard gusts, with rain from the north.

"At 6 P.M. the wind, which had blown from due N., shifted to E.N.E., when there was an abatement in the violence of the storm.

"At 6. 30 P.M. it recommenced with renewed violence, accompanied with thunder and lightning.

"At 8 P.M. blowing very heavily from S.E.

"At 9 P.M. more moderate; heavy rain.

"At 10 P.M. furious gusts from S.S.E.

"At 11. 30 P.M. more moderate.

"At 12. 30, heavy gusts from south, thunder and lightning; then again more moderate.

"At 1. 30 A.M. of the 3rd, violent gusts from south, after which the gale abated, leaving a brisk gale from south, and towards evening S. S.W., gradually diminishing.

"The 4th was fine, with fresh S.W. breezes. The height of the thermometer on the 2nd was 78°; lowest 76°. Quantity of rain from 8 A.M. on the 2nd, to 8 A.M. on the 3rd, five inches two-tenths.

5 inches of rain.

"The damage occasioned by this gale, both at sea and on shore, is immense. Six coasting vessels were wrecked within a few miles of Pooree; and the Imaum Shah of 700 tons, foundered off the coast, and only four men saved out of a hundred. I have had letters from Cuttack to-day, dated the 4th. I am informed that on the 2nd, they had there a smart storm; a few trees blown down, but no material injury done. Cuttack is 50 miles north of Pooree."

The Imaum was supposed to have been seen an hour before she foundered in Lat. 19°. 11′ N., Long. 87°. 58′ E., on the 2nd of October. At that time she had only her bowsprit, and must have been in about the centre of the storm.

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"*Abridged Log of the Honourable East India Company's Steamer,* TENASSERIM, *from Singapore to Calcutta, reduced to Civil Time.*

Tenasserim.

"28*th September,* 1842.—Noon, Lat. 14°. 22′ N., Long. 93°. 45′ E. Narcondam, at 1.30 A.M. bearing W. by N.; fine westerly breeze. P.M. to midnight, winds variable, N. N. W. to W. 4 P.M. Preparis bearing E. by N. ½ N.

"29*th September.*—Fresh breeze N.W. by W. to W. N.W.; no observations at noon. P.M. The same weather. Lat. Account,

Wind foul.

16°. 6′ N., Long. 92°. 15′ E. 10 A.M. Wind north. P.M. Heavy squalls occasionally from N.W. Midnight, wind N.W.

"30*th September.*—A.M. Strong breeze and thick cloudy weather, with a heavy cross sea; set storm-staysails. No observations. Lat. Acct., 17°. 24′ N., Long. 21°. 28′ E. Lying-to. 2 P.M. Wind shifted to a gale from S. S.W., hove-to under storm staysails. 5. 30, strong gale; ship labouring much, and so till midnight.

"1*st October.*—A.M. Wind lulling at intervals; wind S. S.W.

Wind fair.

till 6 A.M., when marked S.S.E. At 9.30, bore away N.W. by N., with a heavy swell. Noon, Lat. Observed, 18°. 2′ N., Long. Acct. 90°.15′ E. P.M. Wind S.E., fresh breezes and rain to midnight.

"2*nd October.*—A.M. Heavy squalls and rain S.E. 6. 30, fresh gale and dark rainy weather, with a heavy *southerly sea.* At 7 P.M. hove-to under storm-sails. At 10.15, in 70 fathoms water. At noon, Lat. Observed 20°. 47′ N., Long. 88°. 10′ E. P.M. Wind S.E. and 55 fathoms; brisk gale to midnight, when fine.

"3*rd October.*—A.M. Wind S.E. Noon, Lat. 20°. 56′ N. Squally. Saw the pilot."

Essex.

The ship Essex, from Madras to Calcutta, at noon on the 1st of October, was in Lat. 16° N., Long. 83°.50′ E. In the afternoon, the weather is recorded as squally, with rain and much lightning, with dense black clouds to the northward. At 9 P.M. the wind was W. N.W., increasing, and a cross sea rising. At midnight, the Essex experienced hard squalls, with a *high sea from N.N.E.*, and barometer falling. On the 2nd October, she had a very high and confused

sea, and at 9.30 A.M. hove-to, with wind at west. At 5 P.M. the squalls being less severe, made sail, and bore up to the E.N.E., when the wind settled in the W.S.W., clearing up. The Essex made a fair wind of the gale from being behind it.

Eliza.

The ship Eliza sailed from Saugor Point at 3 A.M. on the 30th September, with a northerly wind and fine weather, studding-sails set; but she met a heavy head-swell rolling into the Channel. At midnight it fell calm, with baffling airs, alternately from the north and south. On the morning of the 1st October, steering S.S.E. ½ E., she had an increasing breeze from N.N.E., and turbulent cross sea, with the barometer beginning to fall. At midnight, the barometer being at 29·50 and falling, the ship was hove-to, under main-topsail close-reefed, with her head to the E.S.E.; she was, therefore, upon the port-tack. The wind with the Eliza next day continued at N.N.E., until a little before noon, when it shifted suddenly to S.S.E. From this it may be inferred, that she was on the northern side of the centre, although close to it.

It will be for practical seamen to consider, after reading the very interesting report of Captain M'Carthy, whether they would have brought the ship to the wind on the starboard-tack, or have sailed her with the wind on the starboard-quarter, with the view of gaining the southern half of the storm, and obtaining a north wind veering to west.

By being hove-to on the port-tack, in the right-hand semicircle of a revolving gale, the ship Eliza would fall off from the wind, instead of coming up to it. If she forged a-head in this position, she must have been gradually drawing towards the storm's centre.

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"*Report of Captain* M'CARTHY, *Ship* ELIZA, *Civil Time.*

"30*th September,* 1842.—Civil Time, A.M. Light breeze from the southward and fine weather. At 3 A.M. hove up, and made all sail down from Saugor Point; set all studding-sails. At noon, light winds from N.N.E. to N.N.W., and fine weather. Bar. 29·80, Ther. 84·0. Steering down Channel, a very heavy rolling hollow swell, and all possible sail set; the heavy head-swell continued all the way down Channel. At 2.50, Mr. Hand, pilot, left the ship, about two miles above the outer floating-light, and went up in the steamer. Increasing breezes and cloudy; *a strong westerly set,* steering S.S.E. ½ E. At 7 P.M. the light-vessel north, wind from N.N.E. to N.N.W., a heavy dark appearance from the S.E. From sunset to 9 P.M. light winds from northward, with much very vivid lightning to the S.E.; threatening appearance and incessant lightning. At 11, Bar. 29·78. Smart squall from S.E,, with very heavy rain. The barometer stationary as well as the sympiesometer; heavy rain continued. At midnight, fell calm, with baffling airs from northward and southward alternately.

Swell.

Cross seas.

"1*st October.*—An increasing breeze from N.N.E., steering S.S.E. ½ E. about five knots; a turbulent cross sea on, but not high. 4 A.M. strong N.N.E. winds, with squalls and incessant rain, with a cross sea as above. At 6 to 7 A.M. hard squalls and drizzling rain, ship pitching heavily. At 8 A.M. squalls increased, attended with constant rain and windy appearance; reduced sail. Bar. 29·78, not fallen any since yesterday, and Symp. 29·70. It continued steady from 8 A.M. to noon; strong N.N.E. winds, with squalls and much rain; a cross turbulent sea at noon. Bar. fell suddenly to 29·68. At 3 P.M. strong breeze from N.N.E., and rain and thick weather, *wind falling light at times,* and *freshening as suddenly again.** Made all preparations for bad weather, and brought the ship to the wind, under double-reefed main-topsail and fore-topmast-staysail. At sunset strong wind, approaching to a fresh gale, with unsettled thick weather; *wind lulling* and *freshening* at times from N. to N.E., with a cross, turbulent, and agitated sea, and constant rain. Bar. falling a little. From 6 P.M. to midnight, fresh gales and hard-looking weather; no rain. Midnight, Bar. 29·50, and

Bar. fell.

* This is exactly the rising and falling of the wind described in the seventh memoir. H. P.

falling, Symp. 29·42. Close-reefed the main-topsail, and in fore-staysail; hove-to under main-topsail, close-reefed; head E.S.E.

Hove-to on port-tack.

"*2nd October.*—A.M. Commences with strong gales, with squalls, and light rain again; sea high and cross, ship easy and not moving much, shipping no water on deck; lurching at times. Bar. fallen at 1 to 29·30, Symp. 29·22, and falling. Blowing a hard gale, pitching hard, and taking water on deck; increasing gale. Bar. falling fast. At 3.30, increased to a violent gale; steady at about N.N.E., with a good deal of water on deck, when the ship lurched. Bar. fell very suddenly since midnight, from 29·30 to 28·30, and Symp. 28·22, and falling still. Clued up the close-reefed main-topsail, and, although it was run up quick, before the men could get it well fast it blew nearly to pieces. The wind increased suddenly to a violent storm, the drift making a clean sweep over us for several feet above the deck; the weather quarter-boat blew up to the rigging, got a rope round her to the rail. Just about 5.30 A.M. blowing a violent hurricane from about N.N.E., ship laying over three planks of her lee-deck in the water; wind most terrific. The weather quarter-boat broke the davits, blew about ten feet up the mizen-rigging, and lay across and broke the planks in several places. Stove all the full water-casks that were on deck, and hove them overboard to ease the ship, now labouring very heavy, and burying very much to leeward; masts bending and buckling with the force of the wind; ship buried to leeward as high as the rail. At 6 A.M. the foretop-gallant-mast broke off above the cap, and likewise the main and mizen; put an extra batten on the after-hatch with long nails; the fore upper-hatchway caulked down, the ship now laying over, with her lee-side all buried within two planks of the hatchway; the upper part of lee-bulwark swept away, and upper covering-board split, the gun and carriage washed over the rail; the spars on the booms and long-boat all fast, but the board on the booms adrift, the wind having got under the boat, broke her lashings, and blew her to pieces. Bar. still falling since 6 A.M. At present, 8 A.M. (Bar. 27·92, Symp. 27·78), blowing a terrific hurricane; ship much over, the lee-side of the quarter-deck quite buried, and the covering-rail being apparently split, did not know the extent of the damage to the leeward, it being under water. Masts struggling and bending much; the foremast-head gave way, and fore-topmast fell over the side with yards, and our foreyard came down the foremast several feet. Ship not rising at all, and

Wind N.N.E.

Bar. 28·30.

Very violent.

Bar. 27·92.

Ship in danger.

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wishing to wear her to get her lee-side up (hurricane still as violent), cut away the main-topmast backstays, to ease the ship and try to right her, as the fore-topmast going did not appear to do so, and to save the mainmast, when the main-topmast broke some feet above the cap, yards, &c., going with it over the side; still the ship lay over with most of the lee-side of the deck under water; and not rising, cut away the mizen shrouds to ease the ship, when the mizenmast went over the side, taking away the binnacles, compasses, boats, &c. overboard, and carrying away the starboard quarter-gallery, poop-rail, and smashing the skylight and every thing on the poop. The ship righted a little, broke the steering-wheel, and wounded a man on the poop. The sea washed into the starboard after-cabin (the captain's), and nearly filled it, and from it to the cuddy and other cabins, and a large quantity of water got down the companion-hatch, abaft the cuddy, before it could be secured. Since 6.30 A.M., until at

Bar. 27·89.

present, at 11 A.M., it had blown a terrific hurricane. Bar. stationary at 27·89, Symp. 27·78. Still blowing as furiously as ever. About a little after 11 A.M. the wind suddenly lulled very much, got the hands on the poop, got tackles on the tiller, the wheel

Wore.

being broken, and put it up. After some time the ship wore, and cleared the deck of water; the sea knocked her about the stern in wearing, brought her to on the starboard-tack; much

Near the centre.

lightning, and dark overcast weather, heading up N.W. At a little before noon the wind shifted in a flash of lightning suddenly to the S.S.E. from N.N.E., and blew instantly nearly as violent as it had done before from N.N.E.; clapped the hands on the pumps, and kept at them some time; but they were washed away, some rice coming with the water; ship apparently a list to starboard; dark overcast weather, the drift washing over the ship ten feet above the deck; not able to look to windward. Cut away the wreck of the mizenmast, it being now to windward, but not before it had struck the rudder, and shook it very much; it struck likewise under the counter before the ship was wore round, and shook the stern-frame a good deal. Threw every thing overboard that was about the decks, as well as three provision casks (that had washed out from under the topgallant forecastle, where they were stowed), to prevent them from wounding the people, many having had their legs cut and other bruises. Two feet and eight inches in the well, but could not tell precisely, every thing being so wet. Set to work at the pumps, a quantity of rice coming up with the water; pumps working well,

and heaving a large quantity of water. Blowing very violently from S.S.E, *the lee sea coming nearly up to the pumps at times.** Secured the foreyard, and lashed the yardarm of the mainyard down to the ringbolts in the staunchion, and kept it on end, to keep it steady; tried to get something on outside the quarter-gallery, as the cabins were nearly full of water, but could not succeed; the men were washed away. Blew a violent hurricane until 4.30 P.M.; black overcast weather and lightning, when the extreme violence of the hurricane moderated a little; all hands at the pumps; continued at them until nearly 6 P.M., when the ship sucked. A large quantity of water in the cuddy and cabins, and some of it getting below as it washed about; succeeded in getting the quarter-gallery door barricaded with canvas and battens, which kept part of the sea out. At 6 P.M. moderating to a hard gale, and glass rising slowly, from 27·92 to 28·30, Symp. 28·22; both rising together; Symp. moved up first. Succeeded in stopping the water from getting in; got the water baled out of the cabin and cuddy; got some more of the wreck cut away, tiller loosened a little on the rudder-head; got quite pitch dark; sent the men to rest in the cuddy. Bar. 28·50. Ship laying-to, helm down, head E.N.E. to N.E., wind about S.S.E.; cross, turbulent, and agitated sea on, less water on deck, and violence of the storm moderating. From 9 to midnight strong gale and overcast weather; steady at S.S E. Midnight, ditto weather, ship rolling heavy at times. The Symp. rose to 28·96. The barometer got broke, by striking against the side in one of the heavy rolls after the violence of the storm had subsided.

Moderating.

Bar. rising.

Wind S.S.E.

"*3rd October.*—A.M. Strong gale from S.S.E. and dark weather, but clearing away a little; ship laying-to, head to eastward very easy, and decks clear of water, great heat coming up from below. Sunrise, hard gale and fair weather, with passing clouds, wind E.S.E.; ship laying-to under bare poles, but not to the wind; clearing the wreck. Noon, strong winds and fair weather. Symp. 29·40, Ther. 82°. Lat. Obs. 19°.46′, Long. Chron. 88°. Situation by account at midnight of the 1st, when the violence of the gale commenced, and lasted to 4 A.M. on the 2nd October, was Lat. 18°.30′N. (about), and Long. 89°.0′ E. P.M. Strong winds from the southward, and cloudy weather. At 2, Symp. 29·56, Ther. 84°. Squalls

* The italics are mine; this is partly a confirmation of my remarks on the danger of the *lee sea* in the first Memoir.—Vol. viii. *Journal Asiatic Society*, page 645. H. P.

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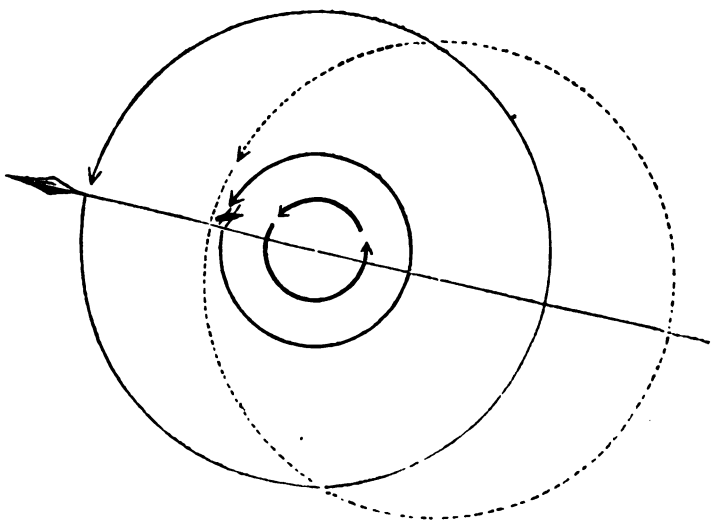
at intervals, and light rain; high sea on from S.E., employed clearing wreck and getting the foreyard up; set the lee part of the mainsail a few cloths to leeward, to keep the ship to, the rest being all blown away, the foresail nearly torn to pieces; very high sea on. Midnight, strong southerly winds, passing squalls at times. Finding ourselves at so little distance from the Sand Heads, and a strong southerly wind blowing and likely to continue, and not being able *yet* to keep the ship to the wind, it being S.S.E. and quite dead foul, we determined to run back. Kept away N.E. by N., under clue of mainsail, going about two knots.

4th October.—A.M. Strong breeze from S.S.E to S., with passing light squalls; kept the ship N.E. by N. ½ N., to check the westerly set that always prevails outside at this time. Noon, sea subsiding gradually, moderate breeze, and fair weather. Lat. by Obs. 20°.12′ N., Long. per Chron. 87°.58′; had a strong set about W.S.W., and shortly arrived safe at Calcutta.

If the centre of a revolving storm be moving directly towards a ship laid-to, the wind will not veer at that ship, if, for the sake of illustration, we suppose her to be stationary. The wind having continued to blow with the Eliza at N.N.E. after she was laid-to, it is



probable, that the centre was moving almost directly to her. In the preceding diagram, the spear drawn across the circles is intended to show the direction in which this storm was moving, when it was passing over the Eliza. The figure will help to explain why the wind might continue to blow at N.N.E., until it should change suddenly to the S.S.E.; the dotted circle being intended for the storm's place about the time when the ship hove-to.

Halifax Packet.

The ship Halifax Packet, appears also to have sailed from the Hoogley on the morning of the 30th September, steering S.S.E., with the wind at N.N.E. The account printed below states, that in the afternoon of 1st October the N.N.E. wind veered to E., showing that this ship also was in the northern half of the storm, and in a position in which she should have come to the wind, upon the starboard-tack.

The same remarks nearly apply to the Halifax Packet as have been made upon the ship Eliza. Whilst the wind was still N.N.E., it might have been a question for the commander of the Halifax Packet, whether in bringing the wind upon the starboard-quarter, he should attempt to gain the southern half of the storm, to obtain a north wind veering to west, or come to the wind on the starboard-tack.

But after the wind had veered to east, it became too late to sail round to the front of the storm. Then to come to the wind on the starboard-tack, provided the swell of the sea would admit of it, would seem to be the proper course to take. On the starboard-tack she would have been led into the latitude which the Tenasserim sailed over at the same time, meeting comparatively moderate weather.

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"*Extract from the Log-book of the Ship* HALIFAX PACKET, *from Calcutta bound to England.*

"*30th September*, 1842.—At midnight the pilot left us on the Sand Heads, all possible sail set. Wind N.N.E. Steering S.S.E. Lat. at noon, 21°.18′ N., Long. 88°.40′ E.; Bar. 29·60, Ther. 82°.

"*1st October.*—During the afternoon of this day the wind increased; double-reefed the topsails; the wind veered from N.N.E. to E. Bar. and Ther. same as yesterday.

"*2nd October.*—At 2 A.M., civil time, Bar. had fallen to 29·70; made all snug. The slings of the foreyard gave way. Got the yard and sail secured across the forecastle, blowing a terrific hurricane. At 4 A.M. the bowsprit gave way, carrying away the foremast near the deck, the starboard bower-anchor-stock, starboard gangway-rail, bulwarks, split the covering board, and stove the long-boat. At 4.30, the main-topmast went over the side, carrying with it the main-cap and part of the mast-head. Cut away as much of the wreck as possible, to save the rudder and ship. The crew, although strong and numerous, very inefficient. At 5 A.M. the typhoon at the highest possible state of fury. The mizenmast went over the starboard-quarter, carrying with it the boom, gaff, binnacles, compasses, broke the steering wheel, and started the upper rudder-brace, also skylight-hatch, signal chest, staunchions, and everything on the poop. The ship completely under water, yet leaking but little. About noon the wind veered to south, and became more moderate; the barometer rapidly getting up, but a high sea, the ship rolling fearfully. Bar. at noon, 28·90, at 8 P.M. 29·00. Lat. 19°.26′ N., Long. 88°.30′ E.

"*3rd October.*—On the morning of this day, cleared away the wreck; saw two ships dismasted, and stern-frame of a third, with the name in white letters, but could not read them. The sea high, and the crew as much disabled as the ship. Everything full of water. Books, charts, clothes, nautical instruments, and one chronometer, all spoiled. Bar. at 4 A.M. 29·40, at noon, 29·50.

"*4th October.*—This day the ship rolled dreadfully, quite under water; nothing could be done but keeping her pumped out. Wind moderated from the south. Bar. 29·70. Lat. 19°.56′ N., Long. 87°.50′ E."

Emerald Isle.

The ship Emerald Isle, which was at anchor in the Eastern Channel, slipped and put to sea, in the after-

noon of the 1st October, and made sail to the southward, with the wind then about east. If her anchors would not hold, it is scarcely possible to conceive a commander of a ship in a more perplexing position; for the wind was about to veer to south-east, and to head him whilst he was entangled with the land.

I reprint the report of Captain Scales, commander of this vessel.

"*Report of the Ship* EMERALD ISLE, *Captain* SCALES.

"On the 1*st October*, 1842, whilst at anchor in the Eastern Channel, the weather became unsettled with the wind at E.; the squalls rising about S.E., but striking us mostly from about E. About 4 P.M. gale and sea increasing, slipped and made sail to the southward. During the night it blew with an increasing sea. About 5 A.M. on the 2nd, wind about E.S.E., gale increasing with such rapidity, that I was unable to shorten sail sufficiently quick, the weather beginning to assume a most wild and threatening appearance. At 1 P.M. the wind and sea had increased to that extent, and the ship so uneasy, I thought we should have been swallowed. Ther. was then 82°, and Symp. 28·30, varying not more than a couple of tenths, until about 6 P.M., when it gradually rose, and the breeze had sensibly abated. The wind had then veered to S. but the hardest part was from the S.E. It blew hard in squalls during the night, with deluges of rain, but by daylight it had almost subsided. The sympiesometer was then 28·40; at noon it rose to 28·50. The wind then gradually drew round to S.S.W."

Slipped and sailed southward.

This gale in its progress, from the 1st to the 5th inclusive, caused the wind at Calcutta to veer from N.E. to S.E. and S., with a slight fall of the barometer.

Gale inland.

At Purulia, the barometer was lowest at 11 P.M. on the 2nd, the wind gusty and E. by S. On the morning of the 3rd it became E.S.E.

At Gya, it blew hard from S.E. on the 5th; and on the morning of the 6th, the wind veered to S.W. At

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Gya the storm lasted 30 hours, and is stated to have blown furiously, accompanied with peals of thunder in quick succession, during the night between the 5th and 6th.

At Pussewa, not far from Benares, the wind on the 5th and 6th veered from the east by the north to the west; whilst at Patna, lower down the Ganges, it veered from the east by the south to the west, as may be seen by the tables subjoined.

The hour at which the wind is reported to have changed at Cuttack from N.E. to S.E. is somewhat later than might have been expected; and there are some discrepancies in the reports of the direction, in which the wind blew with different ships, according to their supposed position. This has led Mr. Piddington to think there may have been two storms; but it is impossible to determine with accuracy the place of a ship in a tempest like this. The difficulty is greater, when it is considered that variable currents are likely to be created by a violent storm, in a confined sea like that at the head of the Bay of Bengal.

"*Report from Lieutenant* SHERWILL, B.N.I., *from Gya.*

Gya. "We had a violent storm at this place on the *5th of October.* It commenced early in the morning of the 5th from S.E. and blew with half-a-gale-like force until nightfall, when its strength increased, and it blew furiously until the morning. About 8 A.M. on the 6th, it veered round to S.W. and blew till noon, when it faded away, having lasted 30 hours, and done some damage by blowing down trees, &c.

"The storm from its commencement until its close, was accompanied by heavy rain, except at short intervals, heavier than had occurred during any part of the time of 'the rains.'

"No lightning or thunder was visible or audible during the day; but during the night, continued peals of thunder followed in quick succession.

"The whole country was flooded from the rain; the tanks filled to overflowing, and in fact the storm has proved a blessing to this part.

(Signed) "W. J. SHERWILL."

Notes made during the Storm of the 5th and 6th of October, 1842, *at Pussewa, twelve miles East of Jounpore, transmitted by* V. TREGEAR, Esq. Pussewa.

Date and Hour.	Bar.	Ther.	Winds.	Remarks.
3rd, Noon.	29·05	...	E.	Fresh breeze, with occasional showers.
.. 6 P.M.	...	...	.....	Breeze rising.
4th, Noon.	29·04	...	E.	Strong breeze, with frequent showers. Clouds in two strata, lower one driving very rapidly to W., upper moving very slowly in the same direction, occasional breaks showing the clear sky.
.. 5.30 P.M.	...	...	.....	Heavy rain, and breeze increasing.
5th, AM.	...	...	E.	High wind and showers.
.. Noon.	29·25	...	.....	Ditto, ditto.
.. 3 P.M.	29·01	...	.....	Very high wind, with rain.
.. 6	...	...	.....	Ditto, and heavy rain.
.. Midnight.			N.E.	Strong gale, with rain.
6th, 3 A.M.	29·00	...	N.	Gale increasing, with violent gusts, which was the character of the storm during the past night; many trees blown down, and innumerable branches broken off.
.. 7	...	72	N.	Violent storm, with rain.
.. 10	29·05	...	.....	Gale continuing, but sky clearing; a few minutes of sunshine; barometer began to rise.
.. Noon.	29·01	76.	N.N.W.	Gale decreasing.
.. 1 P.M.	29·15	...	N.W.	Ditto.
.. 2	29·02	...	N.W.b.N.	Ditto, strong breeze only.
.. 3.40	29·25	...	W.N.W.	Light breeze.
.. 5	...	...	W.	Ditto, low clouds driving very fast to S.E.; heavy bank from N.W., round by N. to S.E.
.. 6	...	...	W.	Heavy rain from N.W.
.. 6.30	...	...	W.	Clearing up, fresh breeze.
.. 8	29·03	78	.....	Cloudy, with very light rain.
7th, 6 A.M.	29·04	80	W.	Clear, with pleasant breeze.

E. C. Ravenshaw, Esq., C. S. Commissioner of Revenue for the Patna district, has furnished Mr. Piddington with the following notes from that station:—

"I observe there has been a heavy gale at Cuttack, on the 2nd October, which extended far into the interior. As it is probably Patna.

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connected with a violent and continued gale experienced at this station, I inclose the very imperfect notes made by me while it lasted.

Date.	Bar. at 10½.	Ther.	Rain.	Remarks.
Oct. 2 and 3	not marked.			Blowing fresh from east.
4	29·81	84	·12	Ditto, ditto.
5	29·73	83	....	Ditto, at 6 P.M.; rain commenced; continued pouring all night; gale increasing.
6	29·51	81	4·50	Gale continues, trees blown down in all directions; wind shifted to the south. At 5 P.M., to the west, from which quarter, until midnight, it blew furiously, but with little rain.
7	29·74	79	·12	Calm.

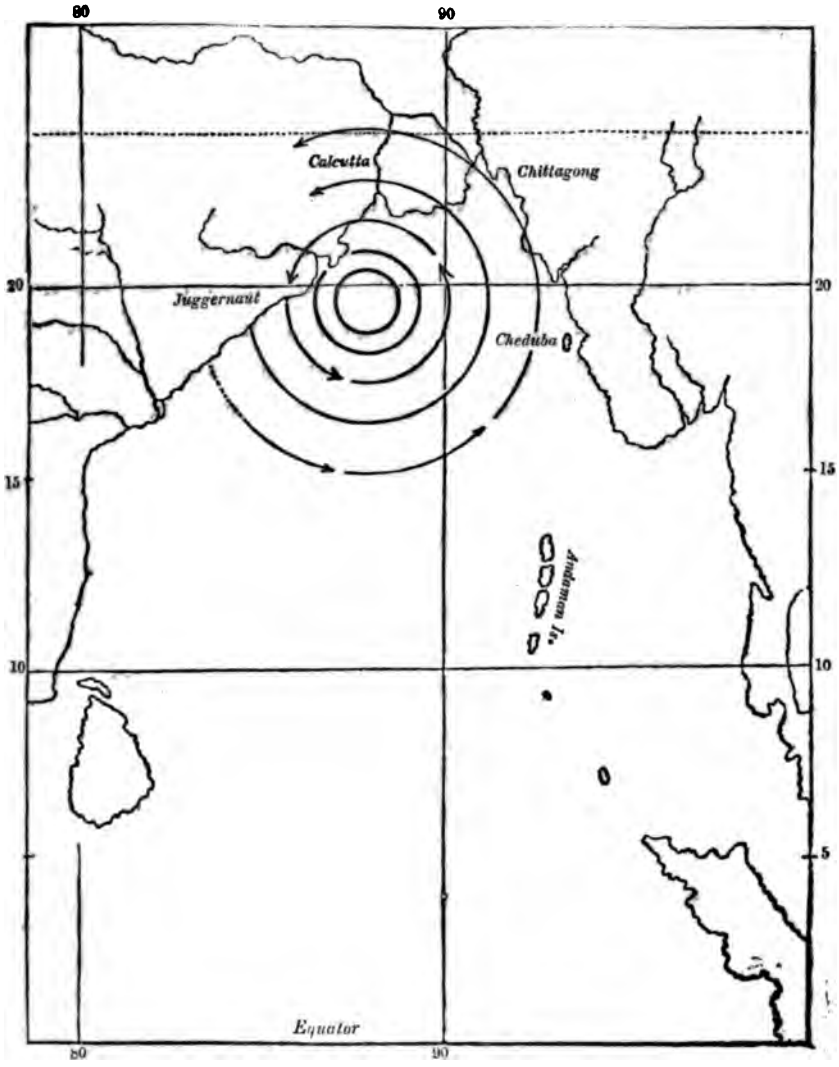
"E. C. RAVENSHAW."

Gale of June, 1839.

Mr. Piddington's first Memoir on Indian Storms, published in the Journal of the Asiatic Society for 1839, relates to a storm at the head of the Bay of Bengal, on the 3rd, 4th, and 5th of June, of that year. Twenty-seven reports relating to it were obtained from different sources. The following figure may serve to show its probable position between the 4th and 5th of June, and to explain the danger ships near the mouth of the Hoogley are exposed to, by a whirlwind storm moving across the bay, from the eastward, with its centre about the 20° of latitude.

The ships which were upon the south side of the same revolving gale, had sea room to stand away from the storm; or, if bound to the northward, to sail round it, by steering north-easterly, towards the Arracan shore.

After an attentive consideration of the published reports on this storm, I am inclined to think, that, like



most storms in this latitude, its progressive movement over the Bay of Bengal, was somewhat to the north of west; as the wind at the Light Vessels, at the entrance to the Hoogley, veered from about N.E., to S.S.E., as the storm passed over them.

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John William Dare.

At the Island of Cheduba, the wind also blew S.S.E. The report from the Commander of the barque John William Dare, which was at anchor off the Island of Cheduba, will be found reprinted here. It gives the set of the swell, which was so great as to cause that vessel's rudder to be unshipped by striking the bottom.

The John William Dare at Cheduba, had the swell on the 2nd from the *southward*, and on the 5th from the *south-west;* but the Petrel, in Lat. 13°. 44′ N., Long. 84°. 50′ E., had a confused sea from the *northward.* The rigging of the brig was covered with red dust.

Red dust.

This storm seems to have lost its regular whirlwind character on meeting with the high land of India, and that portion of the gale, blowing from off the land south of Juggernaut, appears to have been of diminished force.

The figure will show how the Arracan side of the Bay of Bengal becomes exposed to the wind and to the swell during the last half of whirlwind storms, and the situation of the John William Dare exemplifies this.

"*Barque* JOHN WILLIAM DARE, *Captain* GIBSON, *at anchor off the Island of Cheduba in* 3½ *fathoms water, on* 1*st June,* 1839, *Civil Time.* Lat. 18°. 44′ N., Longitude by three chronometers, 93°. 50′ E. Bar. 29·80, Ther. 85°. Latter part fine and clear. Bar. 29·75, Ther. 84°.

"*2nd June.*—First part light breeze and clear, with lightning to the southward. Daylight, freshening breezes, with flying showers of rain and light squalls, barometer falling. At noon, strong breezes with squalls, and dark and threatening appearance. Bar. 29·40, Ther. 89°.

"2 P.M. Breeze increasing; preparing for bad weather. Bar. 29.30. Heavy sea rolling in from the *southward,* ship rolling frightfully.

"8 P.M. Breeze increased to a gale, with tremendous sea. The ship, though drawing only eleven feet six inches water, struck by the heel and unshipped the rudder. Secured the rudder, slipped the chain, cast to seaward, and anchored again in four fathoms water. Latter part, weather as before. Bar. 29·30.

"*3rd June.*—First part, heavy gale from S.S.E. with a tremendous sea; vessel labouring heavily, and making thirty inches of water per hour. Daylight, barometer rising; strong gale, with heavy thunder and rain, and dark heavy appearance all round. Noon, gale abating, with heavy squalls, thunder, lightning, and rain. Bar. 29·50, Ther. 84°. Latter part, gale abating, with heavy rain and a high sea. Bar. 29·60.

"*4th June.*—First part, strong breezes with squalls, thunder, and heavy rain. Daylight, breeze abating. Bar. 29·75. Ther. 85°. Shipped the rudder, and sent up top-gallant yards and masts. Latter part, smart breezes. Bar. 29·80.

"*5th June.*—Smart breezes from S.E., and a high sea rolling in from S.W. Made sail for Chittagong."

Meteorological Register from the Surveyor-General's Office, Calcutta.

1839.	Bar. at Noon.	Ther.	Winds.
June 1	29·536	92·07	N.E. Cumuli; squalls from the N.E. with rain.
2	29·475	90·08	E. b. S. Cumuli; strong squalls and rain.
3	29·428	89·10	Fresh gales with squalls.
4	29·400	86·07	E. b. N. A gale with very severe squalls and rain.
5	No Registers.		E.S.E. Strong squalls veering to S.E.

"*Diamond Harbour. Lat.* 22°.11′.

"*1st June.*—Light variable airs.

"*2nd.*—Variable, cloudy, and frequent rains.

"*3rd.*—N.E. breezes, and rain.

"*4th.*—Strong N.N.E. breezes and frequent rain.

"*5th.*—Strong gales and squally, E. to S.S.E. and heavy rain.

"*6th.*—Wind at S.S.E. and cloudy. Thermometer, from 1st to 6th, 83° to 85°."

"*Kedgeree. Lat.* 21°.52′ N.

"*1st June.*—Light variable easterly winds, cloudy and rain, thunder and lightning.

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"*2nd.*—Cloudy, N.E. squalls and rain, with calms, heavy rain, thunder, and lightning.

"*3rd.*—Heavy squalls from N. to E., and rain, very unsettled appearance.

"*4th.*—Heavy easterly squalls and rain, unsettled weather.

"*5th.*—Smart gale from S.E. to E. and rain.

"*6th.*—Strong breezes S.E. to S. and cloudy."

"*Honourable Company's Upper Light Vessel* HOPE, C. A. HUDSON, *in Lat.* 21°.26′ *N.*

Hope, Light V.

"*1st June, Civil Time.*—Winds light and variable all round, with some rain.

"*2nd.*—Light winds during the first part; at noon, heavy squalls from the east, with rain and thunder; latter part, squally, with wind from the northward at times.

"*3rd.*—First part, variable, and with heavy squalls; noon, wind E.S.E. inclining to a gale; at sunset, gale from E.; and during the night, from E.N.E. with heavy sea; vessel riding with 160 fathoms cable.

"*4th.*—Gale continuing in heavy gusts from eastward, and shipping seas fore and aft. Till noon, the same weather, but wind at E.S.E.; at 8 P.M. gale veering to S.E. with dull gloomy weather, and at midnight, gale at S.S.E.

"*5th.*—To daylight, gale blowing very hard at S.S.E., veering latterly to S. in heavy squalls, with dismal weather and heavy sea on; vessel shipping water fore and aft. At noon, gale decreasing, with rain at sunset. Towards midnight, strong breezes at S. with very heavy sea."

Calcutta Storm of 3rd June, 1842.

A violent storm, the centre of which passed over Calcutta on the 3rd of June, 1842, is made very interesting by the observations of Mr. Piddington, on the appearance of the centre of the storm, during that period when the wind lulls, and before it shifts to the opposite point. I shall therefore reprint his observations here.

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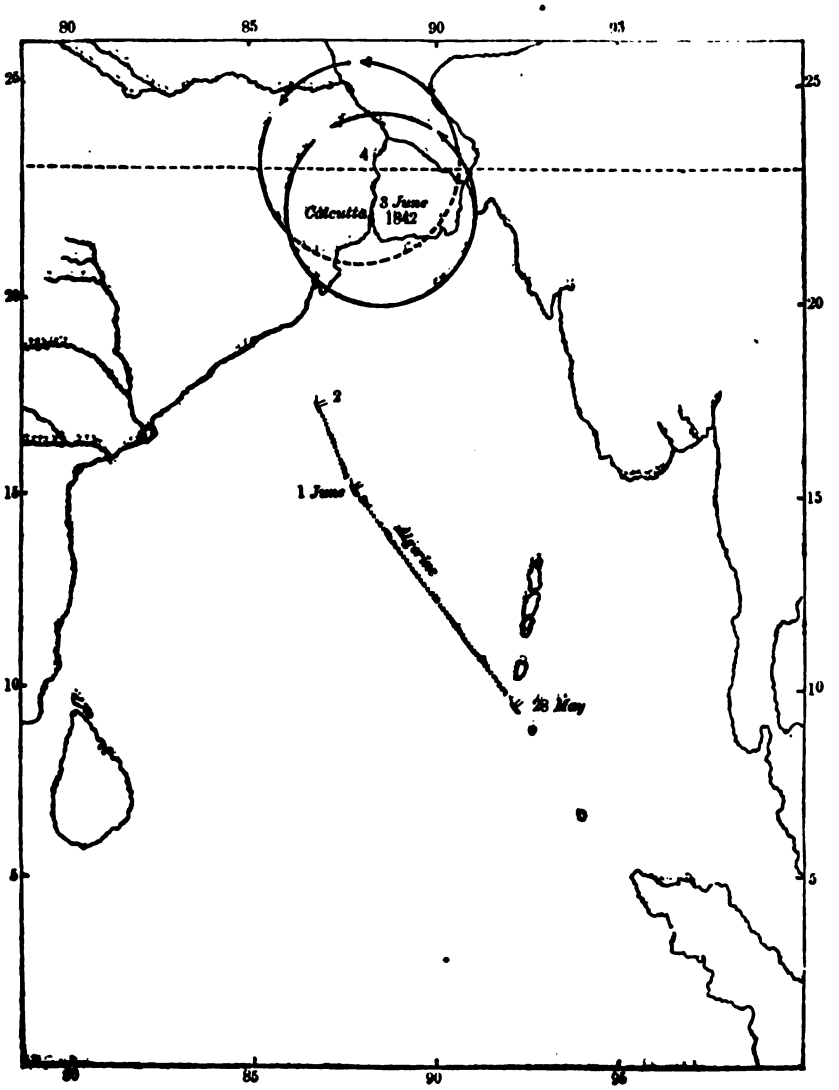
The account of this hurricane forms the subject of Mr. Piddington's seventh Memoir. It seems to have originated in the Bay of Bengal. I shall add an extract from the observations made by Mr. Buckton, commanding the Algerine, which brig's place will be found on the annexed figure.



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Storm of 2nd, 3rd, and 4th June, 1842. Notes by H. Piddington, published in the *Englishman* and *Hurkaru* newspapers.

"During the latter part of May the weather was excessively close and oppressive, particularly during the nights. It was on the 27th that we had the first north-wester, after which the weather was calm.

"*1st June.*—At 6 A.M. the Bar. had fallen from 29·625, at which it had previously been (the usual average of May being about 29·72), to 29·465. The wind was E.N.E., in variable puffs, rising from heavy nimbi and cumuli to the E., and flying fast from about due E. to W. Clear and rather dark blue sky, with light cirri, and strata above the scud. Cloudy and squally during the day. The scud not remarkable in the afternoon, but always coming from E. and S.E., a thick bank hanging to the eastward.

Bar. 29·465.

"*2nd June.*—After midnight, squally from the E. with rain. Daylight, heavy, and rapid scud from N.E.; wind rising and falling. Bar. at 5.30 A.M., 29·355.

"Wind rising and falling very remarkably at varying intervals of fifteen, seventeen, and five minutes, with the peculiar moaning noise which accompanies high and variable winds.

Wind moaning.

"At 10 A.M. Wind N.E. by N., strong squalls, and Bar. 29·355; noon, 29·355. Strong N.E. gale; rapid white scud, with breaks of dark blue sky, and masses of white cumuli.

Bar. 29·355.

"2 P.M. Squalls at intervals, and Bar. 29·265. Calms and squalls to 7 P.M., when Bar. 29·245; but light puffs and calms till 10 P.M., and towards midnight, when Bar. about 29·17. Squalls increasing from N.E.

29·265.

"*3rd June.*—By 7 A.M. Heavy squalls and rain from N.E. At 5.30 A.M., Bar 29·065, Ther. 84°. Hard gale with heavy squalls, scud rapidly flying from N.N.E. and N.E. by N.

A.M.	Bar.
At 6.15 heavy gusts about N.N.E.	29·075
8. 0 N.E. by N.	29·035
8.45	29·015
9.15	28·995
10. 0	28·905
10.30	28·865

A.M.	Bar.
At 11. 0, Ther. 83°, N. by E.	28·735
11.30	28·715
11.45	28·675
Noon, N.N.E.	28·625
0.35 tremendous hurricane gusts at N.E. by N. and N.N.E.	28·475
1. 5 longer intervals between the squalls though yet very heavy	28·370
1.30 at times almost calm, with moderate breezes..	28·535
1.45 calm.	
2. 0 ditto	28·315
2.30 ditto, scud indistinct, but, if driving at all, from E.N.E. to W.S.W.	28·285
3 calm, scud from E., but very slow and indistinct; a light air from E., with drizzling rain	28·275

"At this time I drove out on the esplanade. The appearance of the sky was very remarkable. In the zenith, the haze was so thick that the direction of the scud could not be determined, but to the E. and N.E. it was slowly moving as before, to the W. and S.W. while in the S.; from thick heavy masses of clouds the scud was rising and flying to the N. and N.E." Centre.

P.M.	Bar.
At 3.30 a light squall and drizzling rain about S.W. ..	28·275
4.20 breeze from S.W. increasing fast (the scud having begun to move from the S. about 3.20), with squalls and drizzling rain from the S.W.	28·285
5. 0 heavy gusts from S.S.W. to S.W, scud as rapid from S.W. as before from N.E.	28·320
5.30 tremendous gusts S.W.	28·385
6. 0	28·525
6.30 terrific squalls	28·580
7. 0 ditto	28·650
7.30 very heavy, but more moderate between the gusts	28·710
8. 0 heavy gusts again, S.W.	28·755
8.30 ditto	28·815
9. 0 heavy gusts, but more moderate in the intervals	28·850
9.30 moderating, but with sudden and severe gusts..	28·895
10. 0 sudden gusts	28·925
10.30 ditto, wind perhaps S.S.W.	28·985
10.45 ditto, still with severe gusts	28·995
11.50 ditto	29·000

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	A.M.	Bar.
At	2. 0, June 4th, moderating, but still strong gale	S.W. 29·015
	4. 0 strong moonsoon gale	29·045
	6.10 strong breezes, but at moderate intervals nearly calm	29·105
	10.20 calm, with breezes at times from the S.W. ..	29·215

"From this time till Sunday the barometer was slowly rising to about 29·38, with at times a variable 'monsoon gale' from S.W., with intervals of calm, and at others blowing hard in squalls, with rain."

Extract of a letter from Captain Buckton, commanding the brig Algerine, to Mr. Piddington:—

Algerine.

"On the 28th of May, 1842, in Lat. 10° N., Long 92°.26′ E., the sky became a perfect dense mass of clouds, with the scud flying rapidly past from N.E., S.E., and W.S.W. The wind light, and sea rising in bubbles, as if the wind was blowing from every point of the compass, hissing and rising up in bubbles like a boiling cauldron. Here the barometer fell to 28·60. This being excessively low for so low a latitude, induced us to make every preparation for severe weather. From this time until the 1st of June, Lat. 15°.25′ N., Long. 87°.58′ E., experienced an increasing gale, steady from S.S.W. to S.W. by W., with much lightning, and a very heavy appearance all round. The barometer rising and falling, according to the strength of the squalls, or the preponderance of rain, from 28·70 to 28·56. On the 2nd, civil time, the gale increased, so as to oblige us to lay-to, the barometer having fallen to 28·45. Lat. 17°.20′ N., Long. 87°·6′ E. At 9 A.M. we experienced a cross sea, setting in from S.W., N.W., and N.E., the former preponderating; the rain pouring down in torrents, and squalls blowing in fearful violence from W.S.W., shifting suddenly from that to N.W., to N.N.W., and as far as N.; the barometer gradually falling, until it came down to 28·18. At midnight, more moderate, and the barometer up to 28·36. Steady gale from S.W. by W., decreasing towards noon. At 3 P.M., when in Lat. 19°.10′, Long. 86°.42′, enabled to make sail until 11·30 P.M. of Friday, when the barometer again fell to 28·20 during a most severe squall from the N.W. False Point was then bearing N.W. 12 miles. Here we were obliged to stand to the S.E. for two hours, when we again made sail, and on the following night we were anchored off the tail of the Saugor Sand."

Remarkable state of the sea (see p. 7).

Cross sea.

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On the 19th of May, 1843, the barque Coringa Packet met a small but very severe whirlwind storm off Trincomalee, the progress of which has not been traced. The place of this vessel and her track will be found marked on a diagram at page 89. The day before, the wind was N.E., and the barometer, which was 29·70, had fallen to 29·50. At 2 A.M., on the 19th, the ship was struck by a violent squall from E.S.E. At daylight, it was blowing a "tremendous gale from E. by S.," the barometer being then at 29·30. The sea is described as "running in pyramids," which seems always to be a consequence of a whirlwind storm. About 10.30, the barometer rose to 29·45. At noon, the wind "flew round to N.W. in a tremendous squall," after which the weather began to moderate.

Coringa Packet.

In the middle of the gale, and at the time the barometer rose, a whirlpillar passed across the ship's stern, heaving her round, head to the wind.

Whirlpillar.

On the 20th of May, the Coringa Packet had fine weather, but on the 21st she felt the effect of the heavier storm, marked also in the diagram at page 89. On that day she had "the sea running in all directions," and the wind at W.

Mr. Piddington says, that small whirlwind storms are not unfrequent off the coast of Ceylon, and that H.M. ship Centurion was dismasted in one of them in 1803. In his second Memoir, he has published an extract from the log-book of a ship called the Cashmere Merchant, which encountered one of these small but violent storms, on the 20th November, 1840, off the Island of Preparis, about Lat. 15° N., Long. 94° E. The wind set in at E. by N., and veered by N. to N.W. and to W. There is no record of the fall of the baro-

Cashmere Merchant.

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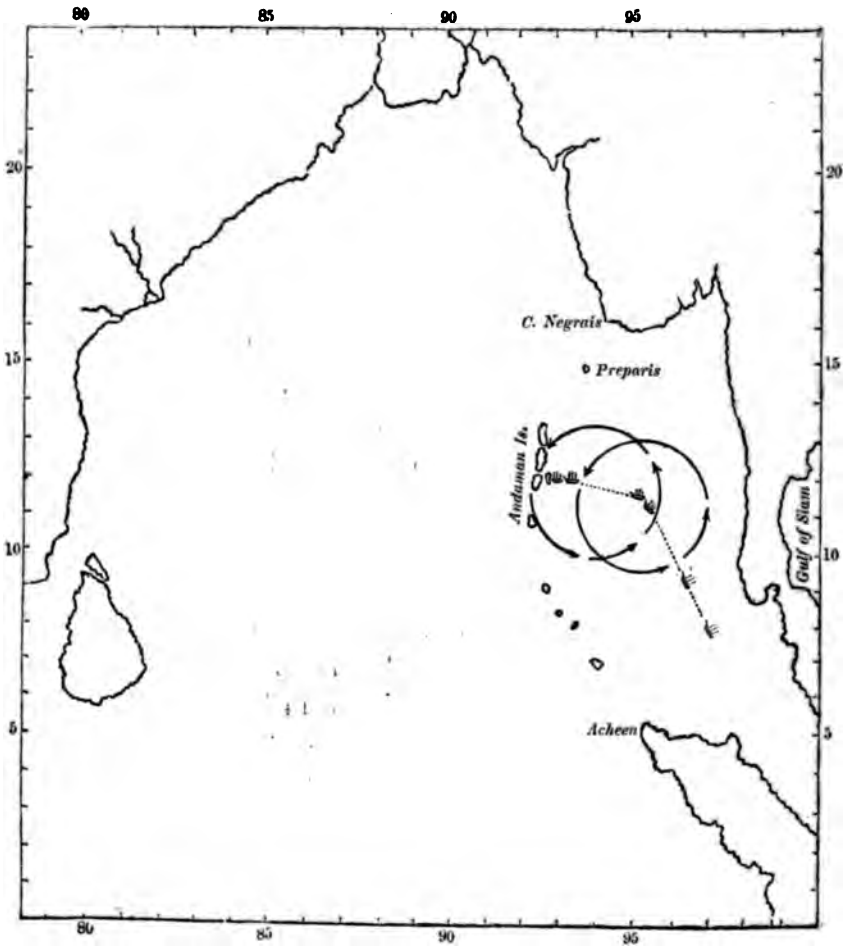
meter, but a cross sea is mentioned. The Cashmere Merchant was thrown over, so that the water reached her hatches; she had her sails blown away, and being rendered leaky, bore up for Coringa.

Briton and Runnymede.

But the most interesting of the small whirlwind storms, described by Mr. Piddington, is that one in which the Briton and Runnymede transports, with troops on board, were stranded together at the same hour in the night, at the same place, on one of the



smaller Andaman islands. The Briton was from Australia, the Runnymede from England. They arrived on the eastern side of the Bay of Bengal at the same time, and when a hurricane was crossing the Andaman Sea.

Abstracts of the log-books of the two transports are here reprinted. These abstracts, together with a figure annexed, representing the hurricane's course, will show how, by shortening sail and heaving-to for six or eight hours, these ships would have had a fair wind, after which, by steering a little to the eastward of north, they would have had more moderate weather.

This storm may have arisen in the Andaman Sea, or it may have crossed the land from the Gulf of Siam.

"Extract from the Log and Chart of the Ship BRITON, *Captain* HALL, *from Sydney to Calcutta, with Troops on board, reduced to Civil Time.*

"*8th November,* 1844.—The Briton was at noon in Lat 8°.25′ N., Long. 96°.55′ E., or about abreast of the Seyer islands, with very light baffling winds from N.E., and cloudy weather, which to midnight freshened gradually to a 4-knot breeze. Wind at 1 P.M. marked north, and for the rest of the log 'variable from S.W. to N.W.' Briton.

9th November.—1 A.M. Course is marked W.b.N. to noon, the wind being from the N.b.W.; at 3.30, strong breezes; at noon, light and fine; Lat. Obs. 9°.10′ N., Long. 96°.30′ E. P.M. Wind freshening fast from S.W. and becoming S.S.W.; at midnight an 8-knot breeze; run 83′ N.W. b. N. from noon. At 6 P.M. dark gloomy weather, and Symp. 29°.30′. At midnight, strong gale, and squally; making preparation for bad weather. On port-tack. Wind S.S.W. Course N.W.b.N.

"*10th November.*—4 A.M. Symp. 29°.20′. To 6 A.M. ran 38′ with head to the W.N.W. 9 A.M. gale still increasing; took in the main-topsail, and lashed a tarpaulin in the mizen rigging. 9.30 A.M. top-masts blown over the side, and all the sails from the yards. Symp. fell from 4 A.M. when at 29°.20′ to 28°.10′. At noon, gale lulled off with showers of rain, and dark gloomy weather. Lat. by Account 11°.1′ N., Long. 95°.12′ E.; Symp. Head W.N.W. Sails blown from yards.

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not rising. P.M. Ship lying-to with head to the W.N.W., the gale having again come on from the S.W. at 0.30 P.M. and blowing with more violence than ever. 2 P.M. terrific hurricane; boats blown to pieces. In the log, wind marked 'variable from N.E. to E.S.E.' At 11 P.M. head 'up N. off N.W.' Midnight, hurricane still increasing.

Centre.

Still on port-tack.

"11*th November*.—Head as before, to noon; the same wind from 1.30. A.M. P.M. Terrific hurricane. 2 P.M. saw a barque about a quarter of a mile to the eastward, with only her lower main and mizen masts standing. At 10 P.M. hurricane lulled off with an awful swell, and dark gloomy weather. Symp. at 27·2 in. At 10.30. P.M. wind veered round to the N.E. blowing with more violence than before, and starting the front of the poop. Throughout this sea log (from noon) ship is marked 'heading from S.E. to N.' and 'wind blowing all round the compass.' Fearful of the poop being blown away altogether, took the chronometers, sextants, charts, &c., all below. Midnight, hurricane still blowing terrifically.

Symp. 27·2.

Ship on shore.

"12*th November*.—1.15. A.M. struck, and at daylight the ship was found high and dry in a mangrove swamp; the Runnymede being close to them. Their Lat. was 12°.2′ N., Long. 93°.12′.40″ E. They were taken from the islands by ships from Moulmein."

"*Abstracts of the Log and Charts of the Ship* RUNNYMEDE, *Captain* DOUTTY, *from England to Calcutta, with Troops on board, reduced to Civil Time.*

Runny-mede.

"*Friday, 8th November*, 1844.—Heavy squalls with unsettled weather nearly through the whole twenty-four hours; winds variable, N.E. and N.W. Lat. noon, 9°.32 N., Long. 96°.35′ E. At 7 A.M. more moderate, sun obscure.

Wind N.N.W.

9th November.—Winds variable. At 5.30, wind N.N.W., squally; in two reefs of the topsails. At 9.30 A.M., wind backing to the westward, tacked to the northward. Noon, sun obscure. Lat. 9°.52′ N., Long. 96°.27′ E. Wind W.S.W., strong breeze, rainy and squally. P.M. Increasing; making preparations for bad weather.

Wind W.S.W.

"10*th November*.—Barometer falling; strong gale W.S.W., with heavy squalls. At 5 A.M. in courses and close-reefed the topsails. At 6 A.M. wind S.W. blowing very heavily, in foresail, and brought the ship to the wind under close-reefed main-topsail and main-trysail.

Hove-to.

"Noon, no observation. Lat. by Acct., 11°.6′ N., Long. 96°.0′ E. Hurricane of wind. Bar. 29·00 and falling. At 1 P.M. ship under main-trysail only. At 1.30 P.M. the fore and main top-gallant-masts were blown away; wind S., blowing very severely, the main trysail blown to atoms; ship under bare poles, and laying beautifully to the wind with helm amidships and perfectly tight; the hurricane accompanied with a deluge of rain. At 4 P.M. wind S.E. blowing terrifically, hatches all fastened down; starboard-quarter boat washed away. At 6.30 P.M. nearly calm, wind backing to the S.W.; sea went down. Bar. 28·45. Kept ship away N. by E. and got the topsails resecured, portions of them having been blown adrift. At 8 P.M., wind S.W., hollow gusts; brought ship to wind on *larboard tack*. At 8.15, hurricane as heavy as before. At 8.30, the larboard-quarter boat was torn from the davits and blown across the poop, carrying away the binnacle, and crushing the hencoops in its passage. At 9 P.M. wind if possible increasing, the foremast broke into three pieces, carrying away with it the jib-boom, main and mizen topmasts, starboard cathead, and mainyard, the main and mizen masts alone standing. At 10 P.M., the wind and rain so severe that the men could not hold on the poop; baling the water from between decks, which is forced down the hatches, but the ship is quite tight, and proving herself to be a fine sea boat. The pumps attended to, drawing out the water forced down hatches, mast coats and top sides forwards.

Kept away N. b. E. and again on port-tack.

Foremast broke.

"11*th November*.—Hurricane equally severe, wind S.E. (Bar. 28·0); the gusts so terrific, mixed with drift and rain, that no one could stand on deck; advantage was therefore taken of the lulls to drain the ship out and clear the wreck. The starboard bower anchor, hanging only by the shank painter and the stock (iron), working into the ship's side, the chain was unshackled and the anchor cut away. Noon, Lat. Acct. 11°.6′ N., Long. 95°.20′ E.; no observations since the 7th. Barometer apparently rose a little. Hurricane equally severe in the gusts, the ship perfectly unmanageable from her crippled state, but riding like a sea bird over a confused sea, *running apparently from every point of the compass*. A large barque, with loss of topmasts and mainyard, drifted a-head of us, and a brig was seen to leeward totally dismasted. At 4 P.M. Barometer fell to 27·70, and Cummins's Mineral Sympiesometer left the index tube. Hurricane blowing terrifically, the front of the poop to leeward, cabin door and skylights torn away, and expecting every moment the poop to be torn off her. *The severity of the wind is beyond description,*

Bar. 28·00. Wind S.E.

Ship unmanageable.

Bar. 27·70.

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there is nothing to compare to it, for unless present, no one could conceive the destructive power and weight of wind crushing every thing before it, as if it were a metallic body. At 1 P.M. no abatement; every one, sailor and soldier, doing all in their power to keep the ship free of water; could not stand at the pumps, the water being principally in the between decks, it was baled out by the soldiers as much as possible.

Baling.

Rudder gone. Ship struck.

"12*th November*.—Midnight, hurricane equally severe, the gusts most awful, and rudder gone. At 1.30 A.M. felt the ship strike, and considered the destruction of our lives as well as ship sealed; but it pleased Almighty God to decree otherwise, for although the ship filled up to the lower beams with water, she was thrown so high on the reef that the water became smooth, and the bilge pieces keeping her upright, she lay comparatively quiet. Not knowing our position, the ship being bilged, and fearful of her beating over the reef into deep water, let go the larboard bower anchor, and found the water leaving her. All hands fell asleep.

"Daybreak, hurricane breaking, much rain, wind E.S.E. (Barometer rising rapidly until it stood at 29·45); we then, thank God, saw the loom of the shore to leeward, the ship being nearly dry abaft. On its clearing away, we saw inside of us, up among the trees a large barque with troops on board; one officer and twelve men were sent over the stern to communicate with her. At 7 A.M. the tide now rising, orders were given for the men to land at next low water, and if possible, to get something cooked, as no fires could be kept in during the hurricane, the crew and troops merely having biscuit and a glass of spirits during the time it lasted. At 3.30 P.M., the tide having fallen sufficiently to wade on shore, Ensign Dabernt returned on board, and stated the vessel in shore of us to be the Briton from Sydney, with 311 men, 34 women, and 51 children, of H. M. 80th Regiment, under the command of Major Bunbury, with a crew of 36 men, bound for Calcutta, and short of every thing."

At daylight saw Briton amongst the trees.

80th Regiment on board.

CHAPTER VII.

STORMS OF THE ARABIAN SEA.

EVERY thing which tends to facilitate the communication between the Red Sea and India is important, and for this reason it is desirable, that the tracks which storms usually follow, whilst passing over the Arabian Sea, should be observed and recorded. In Chapter VI., at page 78, will be found the account of the storm traced by Mr. Piddington in the Arabian Sea, which came from the Bay of Bengal; and another in the same chapter at page 67, which passed over the Island of Ceylon.

A storm which passed along the Malabar coast in April, 1847, appears to have originated over the Island of Ceylon. It has been traced by both Mr. Piddington and Mr. Thom, and accounts of it have been published by each of them, with the reports collected at the time. Mr. Thom's account states, that the circular direction of the storm on the 14th of April, could be traced over an extensive tract of sea and land, including the Island of Ceylon.

On the 15th of April, the whirlwind had extended north, to Cochin and Calicut. And at the Observatory of Dodabetta, on the Neilgherry Hills, the wind was blowing from E. with a pressure of 7 or 8 lbs., and for one hour at 10 lbs. pressure to the square foot. The ship Buckinghamshire, in Lat. 9° N., Long. 73° E., was also within its influence, having the wind at N.E.

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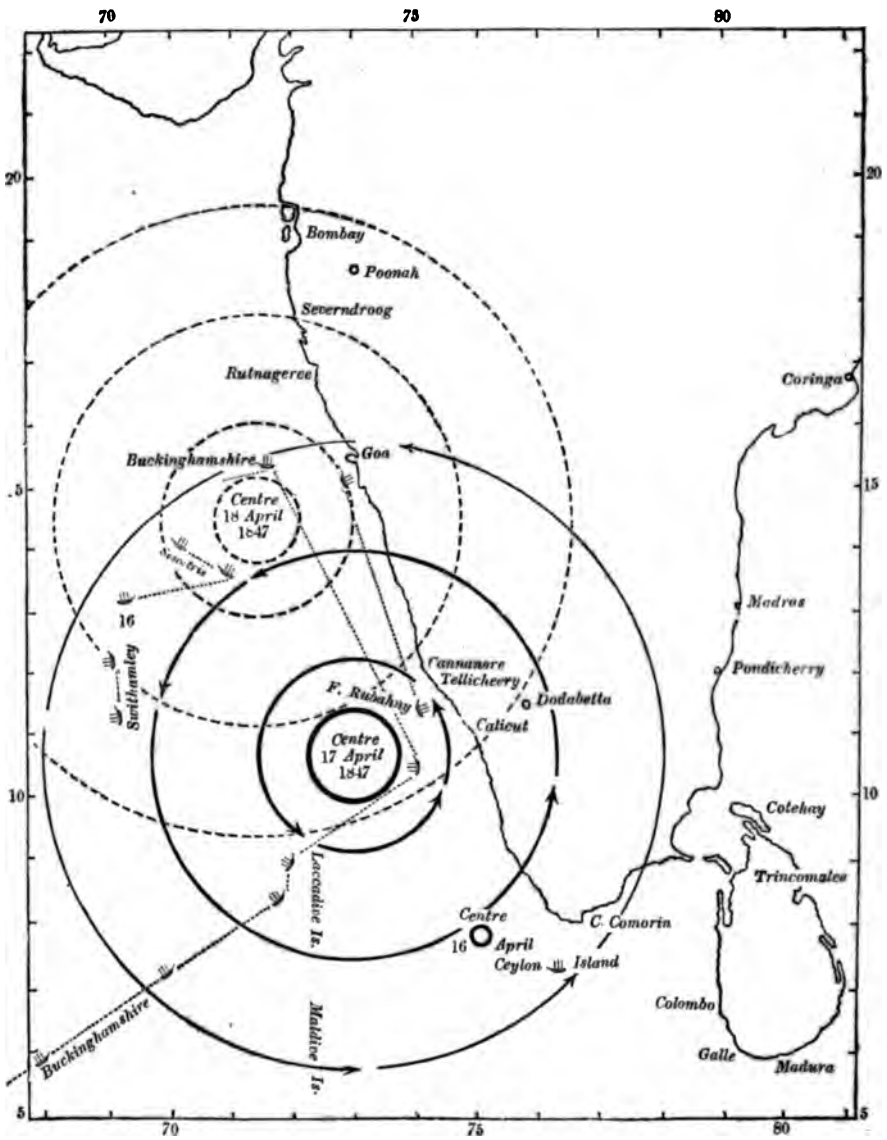
On the 16th of April, the centre is supposed to have been about a degree west of Cape Cormorin, and will be found marked on the annexed diagram. About this time the whirlwind, near its centre, began to



assume the force of a violent tempest; and the Sesostris, in Lat. 13°, had a heavy swell from the south-east.

The continuous circles on the diagram show theplace of this hurricane on the 17th, and the dotted circles represent it on the 18th of April. The very tempestuous part of this hurricane was confined to little more than 200 miles around its centre; but the wind blew at the same time in a circular direction, over a very extensive space, as shown in the diagram.

Mr. Thom says, "While the stormy centre was skirting along the west coast of India, northerly winds prevailed in the Arabian Sea; westerly, near Ceylon and the Equator; southerly and south-east, in the Bay of Bengal; and easterly, in Scinde and Upper Bengal. From whatever intermediate point around, or within this vast circle, we have any account of the wind, it is found not to have veered more than a point or two, from its relative direction to the common centre, except near the coasts, where the land and sea breezes occasionally disturbed its uniformity. The diameter of the most violent and dangerous part, was not much more than 200 miles, whilst that of the great circuit within our cognizance, was nearly 1500 miles. In its early stages it appears to have embraced the coast of Ceylon on one side, and the Maldives on the other."

Diameter 1500 miles.

The progressive rate of this hurricane on the 17th and 18th of April, was about nine miles an hour. It is remarkable that at Bombay there was no violent storm. An extract will be given from the recorded observations made at the Bombay Observatory, which show that the wind there veered from N.E. to N.N.E., to N.W., and W.N.W. Neither is there any account of a tempestuous storm passing near Bombay on either

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side. There were hard gales in the Gulf of Cutch, and over Beloochistan; but it remains doubtful whether these gales were the effect of the Malabar whirlwind storm proceeding to the N.N.W., or whether this violent tempest did not cease to exist on the 19th of April.

It is no less a matter of interest to inquire how and where progressive whirlwind storms end, than it is to discover how and where they begin. Mr. Thom gives statements showing the gradual fall of the barometer from the exterior circle of this whirlwind to its centre, which for the 17th and 18th of April are printed below:—

Barometer on the 17th of April, 1847.

Places.	Distance in Miles from the Focus.	Bar.
Ship Zemindar, Lat. 6°.57′ N., Long. 57°.12′ E.	800	30·00
Madras	300	29·97
Colombo	300	29·86
Steamer Victoria, off Cannamore	120	29·75
Cannanore	100	29·64
Ship Buckinghamshire	90	29·58
Ship Mermaid	60	29·35

Barometer on the 18th of April, 1847.

Places.	Distance in Miles from the Focus.	Bar.
Ship Zemindar, Lat. 7°.42′ N., Long. 57°.39′ E.	900	30·00
Colombo	500	29·86
Madras	480	29·94
Rajcote, in Guzerat	450	29·85
Bombay	240	29·70
Cannanore	130	29·78
Steamer Victoria	130	29·70
Ship Mermaid	80	29·36
Ship Buckinghamshire	20	28·35
Ditto in the focus of storm	...	28·00

Storm current.

A very strong current of the sea, from south flowing towards the north, along the Malabar coast, attended

this storm, which in all probability was owing to diminished atmospheric pressure, combined with the south wind of the storm. Mr. Thom thinks that the steamer Auckland met the reflux of this current whilst on her voyage from Aden to Bombay, in experiencing a southerly current on the 25th, in Long. 62° E., continuing until the 28th, when she was in Long. 72°.

Fall of rain.

Along the track of this storm, and on both sides of the centre, an extraordinary quantity of rain seems to have fallen. The rivers overflowed and the fields were flooded. Mr. Thom has given the following table of the fall of rain at three different places:—

Date.	Quantity of Rain in Inches.		
April, 1847.	At the Observatory at Dodabetta, 3640 feet above the Sea	At Rutragerry, at the Level of the Sea	At Poonah, 1800 feet above the Sea.
15	0·01	....	....
16	1·14	....	0·06
17	4·75	....	0·57
18	10·00	1·50	0·26
19	1·72	4·07	3·05
20	0·09	10·75	2·87
21	....	1·45	....
22	....	....	....
23	....	....	....
Total.	17·71	17·77	6·81

It is added, that at Tellicherry 29 inches of rain fell during the storm.

As the gale advanced along the coast, many of the pattamars (the country vessels) were driven out to sea by the east wind, at the first part of the storm. Some of them were brought back by the west wind blowing at the end of it, but many are supposed to have perished.

Cleopatra.

Among the ships standing southwardly along the

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coast, and meeting the storm, was the H. C. steamer Cleopatra. This vessel had sailed from Bombay for Singapore, with convicts, and it is supposed that she foundered in the centre of the advancing storm, on the 17th of April.

Mr. Thom, speaking of vessels from the northward sailing southerly, and meeting this storm, remarks that, "It is indeed very difficult to suggest any means of escape from a storm such as that of April, which clung to the Malabar coast in its northerly course."

Perhaps the best means of escape for a vessel in the Cleopatra's situation, finding she was approaching a heavy storm, would have been to have steered with the wind on the starboard quarter. (See figure p. 30.) If too near the Laccadives for this course, then to have steered more northerly to have cleared them.

No doubt the Cleopatra at the time was deeply laden with coals and provisions for her voyage, which would render her less buoyant; and this I suppose to be a circumstance necessary for seamen to consider, when approaching the pyramidal sea, always raised near the centre of tempests.

Buckinghamshire.

Regarding the position of the Buckinghamshire, Mr. Thom says, "The Buckinghamshire was more or less involved in the storm from the 13th to the 20th, in consequence of her course being parallel to that of the vortex. On the 14th, she was in the westerly half of the circle, with bad weather at N. and N.N.W.; and as she neared the Island of Mincoy, the N.E. wind delayed her, until the focus of the gale had passed from between her and the coast of India. On the 17th, the gale veered to N.W., enabling her to run 120 miles to the eastward, crossing through its equa-

torial side, crossing its wake, and getting in between it and the land of India. On the 18th, she availed herself of the strong southerly gale on the east side of the vortex, and ran along the coast N.N.W. and N.W. by N. The current and wind being favourable, her speed was eleven to twelve knots an hour. Thus she ran up to the focus, passed a-head of it, with the gale veering from S. by W. to S. and S.E., and in consequence of the jutting out of the coast near Vingorla, she was forced to keep off N.W. by W. at the very time when the vortex was assuming a northerly course, and approximating the land. The result was most disastrous to this fine vessel; and, as we have seen on the afternoon of the 18th, the most violent part of the tempest swept over her.

"It is almost self evident, that had this ship hove-to on the 18th, before she found the wind veering past south to the eastward, she would have escaped the more perilous part of the typhoon. Truth requires that this should be stated; and it is for the guidance of vessels in future, and for the preservation of human life and property, that these remarks are made. But so far from attaching any blame to the officer in command of the Buckinghamshire, we think his conduct, under all the trying circumstances to which he was exposed, has been marked by intelligence, humanity, and zeal for the interest of his employers. He suspected the true nature of the storm, although there was absolutely no previous reason for expecting a rotatory gale at such a season. It was natural that he should avail himself of the southerly, and of course fair wind, at the east side of a vortical storm; and had it diverged from the land, in accordance with the path

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commonly pursued by those noticed in Mr. Piddington's works, all would have gone right."

The Hon. Company's steam ship Sesostris, from Aden towards Cannanore, and the ship Swithamley, coming from the direction of S.W., were both upon the west side of the storm, and wore round to avoid its force.

Dodabetta Observatory.

When the hourly observations made at Dodabetta on the fall of the barometer, combined with the veering of the wind and its force, are closely examined, the great value of that instrument to navigation is strikingly apparent. The tables at page 156, which give the fall of the barometer from the circumference of the whirlwind to its centre, are no less striking. This storm in its progress along the coast of Malabar, produced a variable wind over India, which veered according to the law of the rotation of storms. It is in this manner that North Atlantic gales, when they pass along the coasts of Europe and America, cause variable winds.

Mr. Thom's very interesting account in detail of this storm, is marked as printed at the *Times* press at Bombay, 1848. Mr. Piddington's will be found in the Journal of the Asiatic Society, and forms the subject of his fifteenth Memoir.

Meteorological Observations, made at the Observatory on Dodabetta (8640 feet above the level of the sea).

Date. 1847.	Barom.	Wind. Force.	Wind. Direction	Weather.	Date. 1847.	Barom.	Wind. Force.	Wind. Direction	Weather.
April. D. H.	Inches.	lbs.			April. D. H.	Inches.	lbs.		
15. 0		7·0	E by N		17. 5		20·0	S E ½ E	
1		7·0	E		6		30·0	S E ½ E	
2		6·0	E		7		30·0	S E ½ E	
3		5·0	E ½ N		8		30·0	S E ½ E	
4		4·0	E N E		9		25·0	S E ½ E	
5		3·0	E N E		10		20·0	S E	
6		4·0	E N E		11		20·0	S E	
7		2·5	E by N		12		20·0	S E ½ E	
8		2·0	E by N		13		20·0	S E by S	
9		1·5	E		14		20·0	S by E	
10		1·5	E		15		20·0	S W by S	
11		2·5	E		16		20·0	S W by W	
12		4·0	E		17		20·0	S W by W	
13		5·0	E		18		20·0	S W by W	
14		7·0	E		19		18·0	N E by N	
15		10·0	E		20		15·0	S S E	
16		8·0	E		21		12·0	S E by S	
17		7·0	E		22	22·016	10·0	S by E	o. r.
18		8·0	E		23		12·0	S E by S	
19		8·0	E		18. 0		8·0	S E ½ S	
20		9·0	½ S		1		12·0	S E by S	
21		10·0	E ½ S		2		12·0	S E by S	
22	21·998	6·0	E ½ S	o. m.	3		17·0	S by E	
23		3·0	E by S		4	21·952	13·0	S	o. m.
16. 0		3·0	E S E		5		15·0	S by E	
1		4·0	E S E		6		18·0	S by W	
2		3·0	E by E		7		17·0	S by W	
3		4·0	E		8		15·0	S by W	
4	21·912	5·0	E ½ N		9		17·0	S S W	
5		7·0	E ½ N		10		16·0	S S W	
6		9·0	E ½ S		11		16·0	S S W	
7		8·0	E by S		12		16·0	S S W	
8		7·0	E by S		13		13·0	S S W	
9		12·0	E		14		13·0	S S W	
10		12·0	E ½ S		15		12·0	S S W	
11		12·0	E ½ S		16		15·0	S S W	
12		10·0	E by S		17		15·0	S S W	
13		8·0	E by S		18		18·0	S by W	
14		12·0	E S E		19		20·0	S S W	
15		12·0	E S E		20		15·0	S by W	
16		10·0	E S E		21		10·0	S S W	
17		12·0	E by S		22	22·056	10·0	S W ½ S	c. v.
18		12·0	E S E		23		4·0	W S W	
19		13·0	E S E		19. 0		7·0	W by S	
20		15·0	E S E		1		4·0	W by S	
21		13·0	E S E		2		3·5	W by S	
22	21·946	15·0	E S E	o. r. r.	3		2·5	W	
23		18·0	E by S		4		2·0	W	
17. 0		22·0	S E by E		5		3·0	W S W	
1		22·0	S E by E		6		3·0	W by S	
2		23·0	S E by E		7		7·0	N N W	
3		27·0	S E by E		8		7·0	E by N	
4	21·888	28·0	S E	o. r. r.	9		8·0	E N E	

Bar. lowest. Wind highest.

Bar. oscillating, but rising.

Dodabetta Observations—continued.

Date. 1847.	Barom.	Wind. Force.	Wind. Direction	Weather.	Date. 1847.	Barom.	Wind. Force.	Wind. Direction	Weather.
April. D. H.	Inches.	lbs.			April. H. D.	Inches.	lbs.		
19. 10		5·0	E N E		21. 5	22·084	0·4	W by N	b. v.
11		6·0	E N E		6	22·084	0·3	W by N	—
12		5·0	E N E		7	22·086	0·6	W by N	—
13		7·5	E by N		8	22·094	0·6	W N W	—
14		7·5	E by N		9	22·118	0·7	W by N	—
15		6·0	E by N		10	22·118	0·7	W N W	—
16		6·0	E by N		11	22·110	1·0	W N W	—
17		3·0	E by N		12	22·081	1·0	W N W	b.
18		4·0	E ½ E		13	22·070	1·0	W by N	—
19		2·0	E		14	22·054	0·8	W by N	—
20		2·0	E by S		15	22·050	0·4	W by N	—
21		0·5	E by S		16	22·048	0·3	W by N	—
22	22·138	0·5	E by S		17	22·050	1·7	W by N	—
23		0·5	S W by W		18	22·064	2·0	W by N	b. v.
20. 0		0·3	W by S		19	22·084	1·4	W by N	—
1		0·3	W by N		20	22·096	1·5	W by N	—
2		0·3	W		21	22·119	0·2	W by N	—
3		0·3	W S W		22	22·128	0·7	W	—
4	22·056	0·2	S W		23		0·7	W by N	
5		0·4	S W by W		22. 0		1·0	W by N	
6		0·0	S W by W		1		0·4	W N W	
7		0·0	W		2		0·0	W N W	
8		0 2	W S W		3		0·0	W N W	
9		0·6	W S W		4	22·072	—	N N W	b. v.
10		0·3	W by S		6		—	NW by N	
11		0·1	W S W		7		—	NW by N	
12		0·0	W by S		8		—	NW by N	
13		0·1	W by S		9		0·0	NW by N	
14		0·1	W		18		0·1	W N W	
15		0·3	W by S		19		0·2	—	
16		0·3	W		20		0·0	—	
17		1·2	W		21		—	W by N	
18		1·6	W		22	22.128	—	W	b. v.
19		0·8	W		23		—	N W	
20		0·6	W ½ N		23. 0		—	N N W	
21		0·2	W by N		1		1·0	N N W	
22	22·126	0·2	W	b. v.	2		0·2	N N W	
23	22·124	0·1	W	—	3		0·3	N by W	
21. 0	22·116	0·3	W N W	—	4	22·060	0·3	N by W	c. h.
1	22·100	0·2	W N W	—	5		0·3	N by W	
2	22·092	0·3	N W	—	6		0·6	N by W	
3	22·080	0·4	W by N	—	7		0·4	—	
4	22·078	0·2	W by N	—	8		0·0	—	
					22	22·128	—	—	c. v.

Rain measured at 10 A.M.	April.	In.	Rain measured at 10 A.M.	April.	In.
	15th,	0·01		20th,	0·09
	16th,	1·14		21st,	0·00
	17th,	4·75		22nd,	0·00
	18th,	10·00		23rd,	0·00
	19th,	1·72		24th,	0·00

The mark — in the columns devoted to the wind, represents that the air was too light to act on the vane or pressure plate; as it was also on April 22nd, 5h., 10h. to 17h., and 23rd, 9h. to 21h., and 23h.

(Signed) T. G. TAYLOR, H. C. Astronomer.

Bombay Meteorological Observations, April, 1847.

Date and Obs. Mean Time.	Bar. cor. to 32d Fah.	Air Ther.	Wet Bulb.	Pressure of Moisture.	Wind. Direction.	Wind. Force.	Extent of Cloudy Sky.	State of the Weather.
April 1847. H		°	°			lbs.		
18th, noon								
,, 2								
,, 4	29·628	91·3	76·0	0·714	S.E.	2·08	W	Cirro-cumulus, and fleecy clouds throughout: wind squally.
,, 6	29·666	86·5	73·5	0·670	S.E. by E.	1·56	W	Cirrus, cirro-stratus, and fleecy clouds throughout.
,, 8	29·670	84·4	72·4	0·653	E.	0·05	½	Cirro-stratus and fleecy clouds: zenith partially clear.
,, 10	29·703	84·5	72·5	0·661	E. by S.	0·99	¼	Nimbi scattered throughout.
,, 12	29·663	83 0	73·0	0·690	E.	1·30	¼	Nimbi scattered: light clouds in the zenith, through which some stratus are [dimly seen.
,, 14	29·632	81·7	73·0	0·705	,,	1·56	W	Nimbi throughout: a few drops of rain.
,, 16	29 635	80·4	73·0	0·720	,,	0·42	W	Nimbi throughout.
,, 18	29·669	79·8	71·8	0·682	N.E. by N.	0·52	W	Nimbi throughout, and cumulus and stratus in the horizon: raining very lightly.
,, 20	29 702	81·8	72·6	0·689	N.E.	0 05	W	.. .. Raining lightly.
,, 22	29·705	85·5	74·2	0·709	,,	0·47	W	.. .. .. [throughout.
19th, noon.	29·671	91·6	76·0	0·710	N.E.	0·47	W	Nimbus extending from N.E. to S. horizon (by E.); dense fleecy clouds
,, 2	29·639	85·2	74·0	0·704	E.	1·56	W	Overcast with nimbi: raining.
,, 4	29·590	82·8	72·3	0·667	N.E.	2·08	W	.. .. At 4h.30m. the force of the wind increased to between 4 & 5lbs.
,, 6	29·620	78 0	73·0	0·746	N.E.	0·78	W	.. ..
,, 8	29·634	79·7	74·0	0·764	E.	1·30	W	.. ..
,, 10	29·656	78·5	74·5	0·797	E. by N.	0·99	W	.. ..
,, 12	29·655	76·0	73·0	0·768	N.	0·78	W	.. ..
,, 14	29·628	75·8	74·0	0·807	N.N.E.	1·04	W	.. ..
,, 16	29·633	75·7	74·0	0·808	,,	0·05	W	.. ..
,, 18	29 672	78·0	75·0	0·821	N.E. by N.	0·42	W	Nimbi moving westward: cumulus and stratus in the horizon.
,, 20	29·725	78·9	76·0	0·850	N.E.	0·10	W	.. .. .. raining. (Total fall of rain, 0·31 inch.)
,, 22	29 708	79 2	75 6	0·831	N.E. by E.	0·26	W	Nimbi: raining.
20th, noon.	29·676	82·3	77·0	0·852	N.N.E.	0·36	W	Nimbi and dense fleecy clouds.
,, 2	29·649	86·9	78·0	0·841	,,	0·21	W	.. .. A shower of rain at 3h.52m.
,, 4	29·627	84·9	78·0	0·863	N.N.E.	0·05	W	.. .. At 4h.50m. wind changed (by N.) to N.W.
,, 6	29 656	82·0	79·0	0 937	N.W by W.	0·42	W	.. .. Part of a rainbow visible in the S.E.
,, 8	29·694	81·4	79 0	0·944	W.N.W.	1·04	W	.. ..
,, 10	29·704	80·5	78·5	0 933	,,	0 36	¾	Nimbi: masses of dense fleecy clouds moving S.E.: zenith partly clear. [brilliantly
,, 12	29·693	79·5	78·5	0·944	,,	0·26	¼	Nimbi scattered in the hor.: lightning in continued flashes in S. hor.: stars shining
,, 14	29·662	80·0	77 0	0·877	N.W. by N.	1·04	¼	Black clouds, like cirro-stratus, scattered along the horizon: lightning in S.
,, 16	29·669	78·7	77·0	0·891	N.N.W.	0·00	¼	.. ..
,, 18	28·722	78·6	77·4	0·908	,,	0 00	¾	Nimbi and fleecy clouds below; cirri and cirro-stratus above, moving S.
,, 20	29 754	82 2	79·0	0·935	N.W. by W.	0·05	W	Nimbi and fleecy clouds, the latter below and moving S. E.
,, 22	29·756	85·0	79·4	0·920	W.N.W.	0·42	W	Nimbus extending from N. (by E.) to S., dense fleecy clouds moving to W: black mist extending along the horizon from N.W. (by W.) to S.W.

CHAP. VII.

"*Ship* BUCKINGHAMSHIRE, *from London to Bombay.*
(*Captain's Journal.*)

See fig. page 164.

"*Sunday, 11th April,* 1847.—P.M. Light breeze at N.N.E., and fine clear weather. Departed this life Mariano Francisco. Sunset, lowered the topsails to a squall at northward. A.M. Calm; most of the Chinese and all the Manilla men sick of the scurvy; many dead, others dying. Invited all of them that were able to come to Divine service, to implore the great God, in whose hands are the issues of life. They came cheerfully, which could not be expected from them under ordinary circumstances. Lat. Obs. 5°.17′ N., Long, 67°.50′ E. Bar. 29·92, Symp.29·91, Ther. 89.

Crew sickly.

Whirlpillar.

"*Monday, 12th April.*—P.M. Variable light winds, with squalls. At 2 A.M. a waterspout approached the ship. Bar. 29·88, Symp. 29·82. At 3 A.M. a steady N. N.W. breeze set in and continued to increase. Lat. Obs. 5°.41′ N., Long. 68°.38′. Gt. Bar. 29·86, Symp. 29·84, Ther. 86½. Sick: first officer, 2 Europeans, 5 Lascars, 11 Chinese, and 13 Manilla men.

"*Tuesday, 13th April.*—Fresh breeze at N.N.W. At 8 P.M. cloudy, with lightning all around. A.M. Fresh breeze at northward, and cloudy. Lat. Obs. 7°.11′ N., Long. 70°.49′ E. Bar. 29·86, Symp. 29·84, Ther. 86½. Sick: first officer, 2 Europeans, 5 Lascars, 11 Chinese, and 13 Manilla men.

"*Wednesday, 14th April.*—P.M. Fresh breezes at N.W., and fine weather. Midnight, squally, constant rain, and much lightning.

Bar. falling.

Bar. 29·86, Symp. 29·86. A.M. Wind at N.N.E. and N., with fine weather. Lat. Obs. 8°.18′ N., Long. 72°.56′ E. Bar. 29·85, Symp. 29·84, Therm. 81½. Sick: first officer, &c.

Ship Buckinghamshire, from London to Bombay. (*Nautical Time.*)

H.	K.	F.	Courses.	Winds.	Bar.	Sym.	Ther.	Remarks.
P.M.								April 15, 1847.
1	9	4	N E ¾ E	NW byN	29·72	..	..	Strong breeze and
2	8	4	....	....	29·72	29·74	83	cloudy; in royals. 0.30
3	6	..	NNE b. ½ E	....	29·72	29·73	84	P.M., saw the Island of Monicoy from aloft. 1.30, Monicoy by S.S.E. by S.
4	5	..	E N E	Northerly	29·70	29·69	..	Increased breeze, with a very threatening appearance to the eastward.
5	5	..	....	....	22·67	29·69	..	In top-gallant sails and bonnet of the rib.
6	5	..	E byN	N byE	..	..	..	In first reefs.
7	4	..	....	....	29·71	29·71	..	Heavy squall at northward, carried away both foresail-sheets.

Noon.

Threatening to the eastward.

Squall from northward.

Ship Buckinghamshire, from London to Bombay—continued.

H.	K.	F.	Courses.	Winds.	Bar.	Sym.	Ther.	Remarks.	
P.M.								April 15, 1847.	
8	3	..	....	....	29·70	29·72	..	Dismally dark night, with the most vivid lightning.	
9	3	..	....	....	29·75	29·76	80½	Fresh gales, hard squalls, and constant, heavy rain.	
10	2	4	NW by N	N E by E	..	..	..	Split the fore-topsail,	
11	2	4	N N W					foresail, and mainsail.	
12	2	4	....	....	29·74	22·75	81	Midnight, fresh gales, with constant heavy rain and lightning.	Midnight.
A.M.									
1	3	..	N by W						
2	3								
3	2								
4	2	..	....	....	29·67	29·71	80½		
5	3	..	....	....	..	29·74			
6	3	..	....	....	29·71	..	..	Bent the best foresail and set it.	
7	3	..	....	....	..	..	..	Fresh gales, severe	
8	3							squalls, and a heavy sea.	
9	2	..	N by W½W	....	..	..	..	Passed a Maldiva boat	
10	2							scudding before the gale.	
11	2	..	....	....	..	..	..	Fresh gales and cloudy.	
12	2	..	....	....	29·67	29·72	81½	Lat. Obs. 9°. 0′ N., Long. 73°. 4′ E.	
P.M.								Friday, 16th April.	
1	3	..	NNW½W	N Easterly	..	..	..	Heavy sea at eastward.	
2	3	4	....	N E by E	29·64	29·72	81	Fresh gales and con-	
3	3	4						stant rain.	
4	3	4	....	....	29·64	29·71	81	Double reefed main and mizen topsails.	
5	3	..	....	....	..	..	..	Down royal yards.	
6	3	..	....	....	29·71	29·73	81½	Wore ship.	
7	3	4	S E						
8	4	..	....	....	29·72	29·71	81	Heavy head sea.	
9	2								
10	2	..	....	....	29·73	29·73	81½		
11	3	4	....	....	..	..	..	Fresh gales with se-	
12	3	..	....	....	29·69	29·70	81½	vere squalls of rain.	
A.M.									
1	3								
2	2	4	....	....	29·58	29·60	80¾	Cleared up, and furled	
3	2	4						foresail.	
4	1	4	S E by E	N Easterly	29·51	29·55	81	Strong gale, and cloudy.	
5	1	4	....	....	..	..	..	Very high sea.	
6	1	4	....	....	28·51	29·54	81		
7	1	4	....	N E by N	..	29·61			
8	1	4	....	....	29·60	29·63	81		
9	1	4	....	....	..	..	..	Noon, hard gale with a very high sea.	
10	1	4	....	....	29·58	29·61	82		
11	1	4	....	....	..	..	..	Lat. Obs., Long. per	
12	1	4	....	N by E	29·53	29·57	81½	Chron. 72°. 58′ E.	

CHAP. VII. *Ship Buckinghamshire, off Minicoy, off Cochin, and off Goa, scudding before a Southerly Gale, April,* 1847.

	H.	K.	F.	Courses.	Winds.	Bar.	Sym.	Ther.	Remarks.
	P.M.								Saturday, 17th April.
Fresh gale.	1	3	4	E S E	N by E	..	..	..	Fresh gales, hard squalls, and rain, with a heavy high sea. Kept away to sight Minicoy, or to get to the east of it before night, having obtained a sight of the sun for longitude, but not for latitude. Sunset, hard gales, heavy head sea, and violent squalls of rain.
	2	3	4	E by S ½ S	Northerly				
	3	5	4						
	4	5	4						
	5	6	4	E S E	N by W				
	6	6	4						
	7	7	4	E N E	N N W	..	..	..	Bearing on the longitude of Minicoy without seeing it; hauled up to E.N.E., wind changing rapidly to W., but the weather not improving.
	8	7	4	....	N W				
	9	7	4	N E by E	W N W				
	10	8							
	11	8							
	12	7	4	....	....	..	..	..	Midnight, hard gales, constant light rain, and lightning to northward.
	A.M.								
	1	8							
	2	8	..	....	W S W	29·58	29·60	81½	
	3	8	4						
	4	8	4	N E	S W by S	..	..	..	Squally, with heavy rain.
	5	8	4	N E by N					
	6	8	4						
	7	8	4	N N E					
	8	9	..	....	S S W	..	..	..	Set maintop-gallant sail over the double reefs.
	9	9	..	N by E					
	10	9	4	....	....	..	..	..	Sick: first mate, 2 Europeans, 22 Lascars, 11 Chinese, and 14 Manilla men. Fresh gales, and squally. Lat. Obs. 10°.20′ N., Long. 75°.5′ E.
	11	9	4						
	12	9	4	N ½ E	S by W ½ W				
									Sunday, 18th April.
Strong gale.	1	11	..	N N W	S by W	..	..	..	Strong gales, squalls, and rain.
	2	11							
	3	11	..	....	....	..	..	..	Bent the second foretopsail, and set it double reefed. Strong gale and thick weather.
	4	11	4						
	5	11	4						
	6	11	4						
	7	11	4	N N W ½ W					
	8	12							
	9	12							
	10	12							
	11	12							
	12	12	..		....	..	..	..	Midnight, strong gale, and cloudy.

Ship Buckinghamshire, off Minicoy, off Cochin, and off Goa, (concluded).

H.	K.	F.	Courses.	Winds.	Bar.	Sym.	Ther.	Remarks.
A.M.								Sunday, 18th April.
1	12							
2	12	..	....	....	..	..		Strong gale, squally, and lightning.
3	11	..	....	Southerly	..	29·50		In main-top gallant-sail.
4	11							
5	11							
6	11	..	....	....	..	..	..	At daylight passed a vessel with loss of top-masts and mizenmast, displaying a British ensign inverted; she proved afterwards to be the Mermaid, Rogers, from Bombay. She ran on shore, *sinking* the next day five miles below Vingoria. At 8 A.M. passed an Arab ship with loss of jib-boom, fore-top gallant-mast, and on starboard tack. A.M. Threatening weather, and all the glasses falling rapidly. Furled the mizen topsail; in an attempt to take in the main, it blew away. At noon, the gale being augmented to an extraordinary degree, kept the ship before it.—Bar. last marked 28·35 about this time.
7	11	..	NW by N	S S E				
8	11							
9	11							
10	11	..	....	S E by S				
11	11							
12	11	..	....	S Easterly				

Storm

"*Ship Buckinghamshire in a Hurricane off Goa*, 1847.

"REMARKS.—*Monday, 19th April*, 1847.—The gale blowing furiously and veering to the eastward; cut the foresail from the yard and hauled it on deck; the fore-topsail blew entirely away. At 0.30 P.M. the ship inclined to broach-to, cut away the mizen-mast and kept her before it; blowing a hurricane, blew away the main-topmast, the hurricane increasing, and the foremast bending to its force. About 1 P.M. the foremast fell over starboard; a most furious gust blew away the mainmast near the deck; the quarter-boats blew away, the starboard or large cutter flying across the poop. The poop ports having been blown in, the violence of the wind blew down the backheads, destroying the barometers, and everything in the cabins. The ship covered with spray and labouring excessively in a tremendous sea, the rapidity of her motion tearing everything on the different decks and in the hold adrift. Men unable to stand on their legs, or to hear one another shout. 2 P.M. the wind, which had been for the last half hour indescribably furious, suddenly ceased entirely.

become furious.

Main and fore masts fell.

Calm.

"The Sympiesometer in the calm continued to stand at 28·08.

CHAP. VII.

Ship crossing storm's centre.

The fore and mainmast, which had got under the bottom, were now cut adrift. The ship covered with aquatic birds, thousands of them dying on the deck. About 4 P.M. the wind, that had ceased at E.S.E. or E., began to blow with equal fury at W.N.W. The ship was again enveloped with the sea, and labouring with a violence that nothing could resist; 3½ feet water in the hold. At 9 P.M. the wind abating; Symp. 28·96. At midnight, moderate wind at W.; Symp. 29·1. Daylight, squally at W.; commenced rigging a jury foremast; Chinese at the pumps. At 9 A.M. saw the Vingorla rocks by N.E.½E.; crew at the pumps. Noon, squally at W., with showers.

"*Ship Buckinghamshire dismasted, bearing up for Vingorla.*

"REMARKS.—*Tuesday, 20th April,* 1847.

H.

1. Set the fore-topmast staysail and a fore-top gallantsail on the jury foremast, and bore up for Vingorla.
4. Westerly breeze and squally. Passing about 2° south of the Vingorla Rocks
7. Light breeze and squally with showers. S. Vingorla Rock W.½N. At 7.30, anchored with the larboard bower in 9½ fathoms.
10. Burnt blue lights.
12. Fresh westerly breezes.
6. Turned the men out to the pumps.
8. A vessel with only her foremast standing, and steering by a spar over the stern, running in to the rocks.
11. Fresh W. S.W. breeze and fine. The stranger firing guns.
12. Sent a letter on shore in a water-cask.

"*Ship Buckinghamshire off Vingorla.*

"REMARKS.—*Wednesday, 21st April,* 1847.

H.

1. Moderate westerly wind and squally.
3. Moderate W. S.W. breeze and cloudy.

(We have been since told that Major-General Morse came down to the beach this afternoon and offered 200 Rs. to any boat that would come off to us; but although the weather was moderate, such was the terror caused by the recent loss of life and property, that there were no volunteers.)

11. Variable and squally night, heavy rain.

y, with heavy rain. Filled some casks with rain water, t water having found its way into the ship's tanks during ne hurricane,
Collecting pieces of beef and pork, and other provisions, amongst the coals, the casks having been smashed.
12. Fresh breeze and squally; rigging a jury mainmast."

Ship Essex.

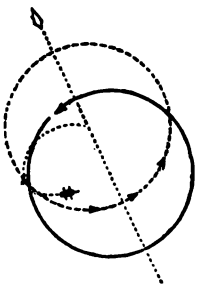
Mr. Piddington gives a short account of a storm met by the H. C. ship Essex, on the 4th and 5th June, 1811. This ship, bound to Bombay, was on the 3rd of June in Lat. 16°.38′ N., Long. 69°.32′ E., with a light breeze from north, which freshened in the afternoon with cloudy threatening appearance and a high confused sea, breaking in all directions. At 5 P.M. the wind became N.E. with lightning in the S.W.

Next day, the 4th June, the ship was hove-to under bare poles in Lat. 16°.19′, Long. 70°.12′ by account, the wind veering from N.E. to N.N.E., and to N. by E., at midnight, when the log-book describes the wind as blowing a hurricane.

Dismasted.

At 1 A.M., on the 5th June, the ship lost her main and mizen masts. At 5 A.M. the wind shifted to N.W.; at 8 A.M. it shifted to W.S.W. in a tremendous squall, the ship being then ungovernable. At 4 P.M. the weather cleared up with the wind at W.S.W.

From this statement, the storm encountered by the Essex was moving about N.W. by N. in the direction shown by the spear-head in the following figure. The dotted circle represents the storm's place after it had passed over the Essex. The ship's course, supposing she had sailed with the wind on the starboard quarter, is also marked. The figure will show that had the Essex sailed in this manner, she would have



avoided the strength of the gale, and by waiting, would have had a westerly wind, fair for Bombay.

Mr. Piddington also makes mention of a very destructive hurricane, which occurred at Bombay, on the 14th June, 1837, in which the wind veered from E. to S.E. and S.S.W., which would also give a N.W. by N. course for that storm.

It is hopeless at the present moment to expect to trace the storms of the Arabian Sea, which recurve over Arabia and Persia. But great pains are now taken by the Peninsular and Oriental Steam Navigation Company, to enforce attention to making the log-book journals on board all their ships valuable records. This will lead at no distant time, not only to make us better acquainted with the storms of the Arabian Sea, but also enable us to connect them with the gales of the Red Sea. It will give the means of tracking the gales of the Mediterranean, and of ascertaining the courses of storms on the European side of the Atlantic.

CHAPTER VIII.

TYPHOONS OF THE CHINA SEA.

At the commencement of his sixth Memoir, Mr. Piddington says, that it occurred to him that it would be of great interest to collect the records of past times, and with this view he addressed the Court of Directors of the Hon. East India Company. He adds that, with their well known liberality in the cause of science, his request was promptly complied with, and that he owes to their assistance, and to officers belonging to the East India Company's service, the possession of a large mass of documents relating to the China Seas.

Mr. Piddington has now added proof sufficient to what was before known, so as to leave no doubt that the typhoons of the China Seas, north of the Equator, are in their nature similar to the hurricanes of the West Indies. They seem to occur, also, at the same seasons. Of thirty typhoons in the China Seas, of which Mr. Piddington has published accounts, one occurred in June, four in July, five in August, ten in September, seven in October, and three in November. Like the West India hurricanes, the typhoons are whirlwind storms coming from the eastward, and moving westerly, having generally, but not always, a northerly progression. The general tendency of whirlwind storms within the tropics, is to move obliquely

CHAP. VIII.

towards the poles, across the trade wind or monsoons: but some exceptions have been met with. A hurricane which passed over the Island of Tobago in the West Indies, on the night between the 11th and 12th of October, 1847, was encountered on the 10th by the barque Copia in Lat. 12° N., Long. 54°. W., or about a degree further north than the Island of Tobago. This hurricane afterwards passed over the Island of Magarita in Lat. 11°, and along the coast of Venezuela beyond La Guyra, when all trace of it was lost. Mr. Piddington seems to have found other similar instances amongst the storms of the China Seas. It is not probable that storms would continue to move on towards the Equator and pass it: they would either subside or change their direction. We cannot conceive a rotatory storm to pass the Equator without subsiding, since the mode of revolution would be reversed.

See Chart facing title-page.

Table of Periods of change of the N.E. and S.W. Monsoons at Canton for six years, compiled by Mr. Redfield from the Canton Register:—

	Vernal change from N.E. to S.W.				Autumnal change from S.W. to N.E.			
1830	from	20	to	28 April	from	5	to 12	October.
1831	„	7	to	17 „	„	1	to 14	„
1832	„	4	to	7 „			on 25	September.
1833	„	9	to	14 „	„	9	to 30	„
1834	„	3 April	to	8 May	„	19	to 30	„
1835	„	8	to	24 April	„	10	to 24	„

Storms have been met as far south as Labuan, which is about the fifth degree of latitude, but they seem generally to be first encountered in about Lat. 14° or 15°. Ships from Singapore, sailing northward towards Canton, meet them on the side on which the wind

Ships sailing northward;

blows westerly; and in general they will only have to shorten sail, to avoid falling deep into them. It may be even necessary to wear, and stand to the southward; but by waiting until the centre of the storm passes by, they will have the south-west wind of the whirlwind, which will be a fair wind for their voyage.

Ships sailing southward,

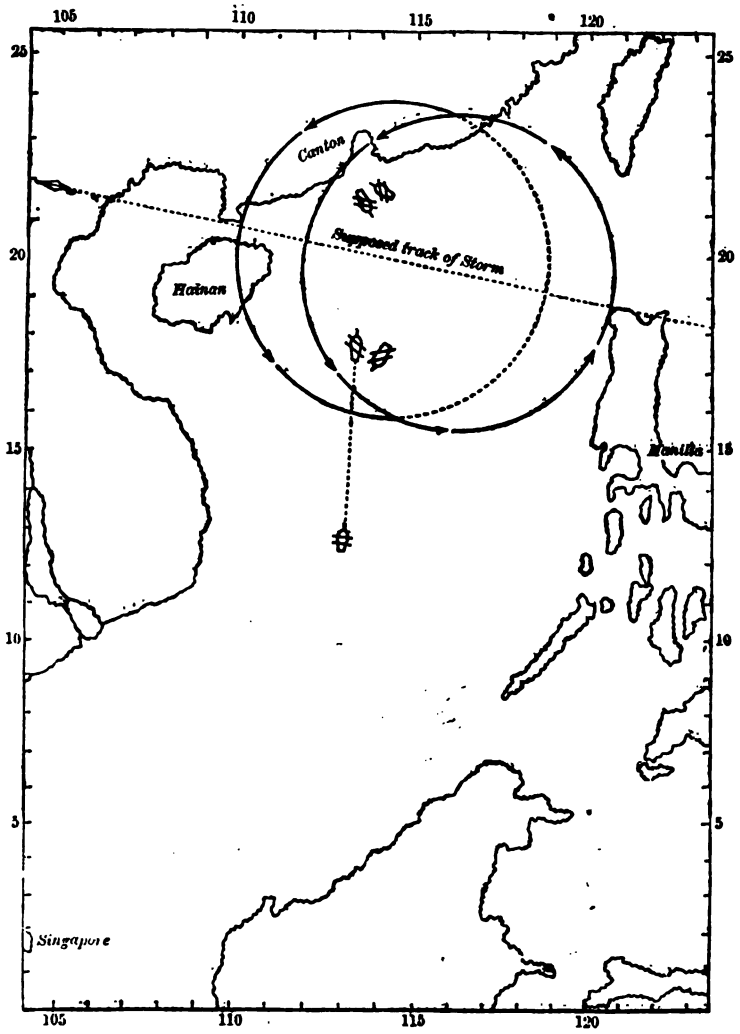
But ships leaving Canton for the southward or eastward, will be in a much more difficult situation, when they fall into a whirlwind storm, with its centre about the eighteenth or nineteenth degree of latitude. They will be much in the same predicament as ships which leave the Hoogley, and meet a storm crossing the Bay of Bengal. Ships leaving Canton will be in danger of being drifted by the currents, supposed to be caused by the storm wave, and by the east wind of the whirlwind, either upon the coast of the continent, or upon the Island of Hainan. Whilst they are in the northern half of the storm, the port-tack draws them towards the centre; and when on the starboard-tack, they will draw towards the land until the wind veers sufficiently towards south, to enable them to lie clear of it.

differently circumstanced.

A diagram is added here to show the difference of these positions. The small charts which follow, with the descriptions of the typhoons which they represent, will all help to illustrate what is here attempted to be explained.

In the typhoon of 1803, there were ships both on the north and south sides of that whirlwind storm. It serves as a good practical example, of the principles of sailing suggested above; and the object of this chapter, is to lead practical seamen to consider beforehand in what manner they should lay their ships, under the varying circumstances which

CHAP. VIII. may occur, when they fall into typhoons crossing the China Seas.



Typhoon of 1803.

Amongst the extracts from log-books obtained by Mr. Piddington, and published by him, were those of the Hon. East India Company's ships Warley, Royal

George, Bombay Castle, Alfred, Coutts, Earl Camden, and Ganges, which experienced a storm in the China Sea, in September, 1803. The three first were not far from Macao, and had the wind north-easterly, veering to east and south-east, whilst the other four ships had a westerly wind veering to south-west. But the Ganges, one of these four ships, by running N. $\frac{1}{4}$ E. 143 miles in 24 hours, ran into the northern semicircle of the storm on the 23rd September, and therefore had a S.E. and E.S.E. wind.

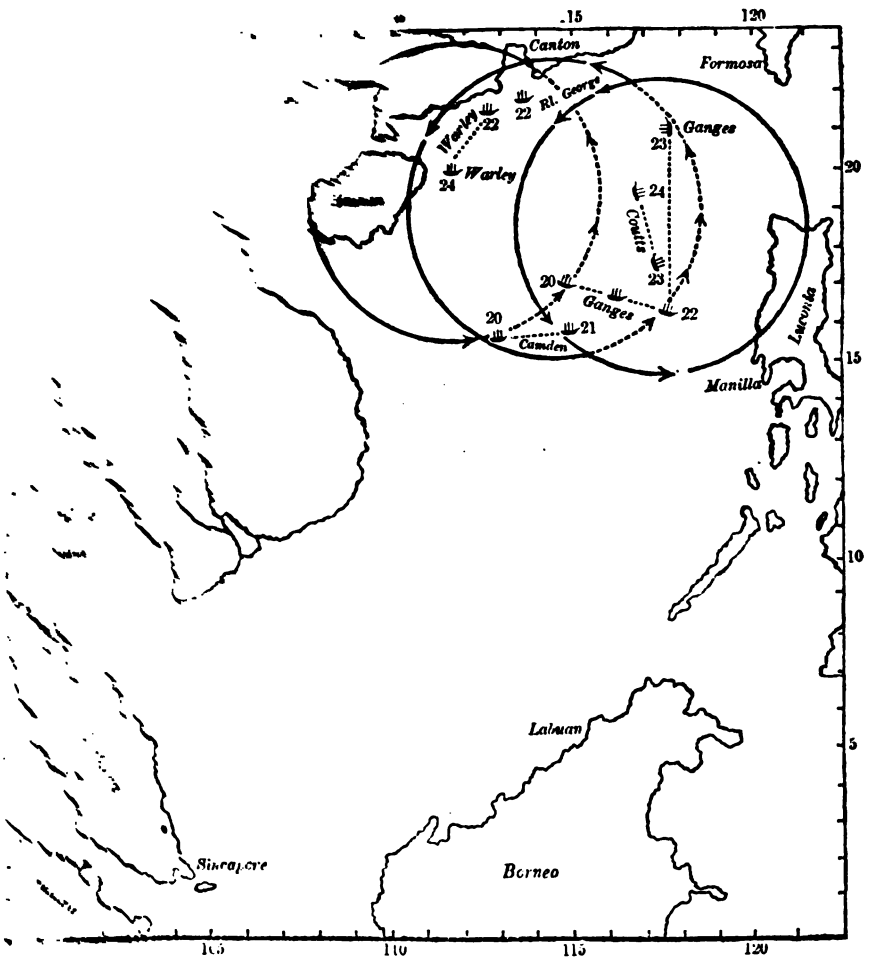
I have constructed the following diagram to show in what way I think this storm passed over all these ships, giving to each the wind assigned to it in its own log-book.

The Warley was drifted to within sight of the Taya Islands, a rate of somewhat more than three miles an hour. The Royal George, under bare poles, was nearly being drifted on another island; a mizen storm stay-sail was bent, and it stood. It was seen by marks on shore to give the ship head-way, and enabled her to clear the land.

Swell.

In the Alfred's log-book, for the morning of the 22nd September, when the wind was north, it is noted, that a heavy swell was rising from the eastward; and again in the afternoon, a long swell from the east is recorded. This will be understood, by turning to the diagram made to explain the Raleigh's typhoon further on.

If this typhoon pursued the usual track of storms, it most probably passed on the north side of Calcutta. Progressive whirlwind storms, which occur in the southern part of the China Sea, in all probability, when they do not subside, pass also over the Bay of Bengal.



CHAP. VIII. The extracts from the log-books of these six ships are here reprinted.

"*Abridged Log of the Honourable Company's Ship* WARLEY, *reduced to Civil Time.*

Warley. "The Honourable Company's Ship Warley was on the 21*st September*, 1803, at noon, in Lat. 21°.17 N., Long. 113°.7′ E. Land about St. John's and the Mandarin's Cap in sight at sunset; blowing fresh from N.N.E. to N. by W. at midnight, when she was in 25 fathoms water.

"22*nd September*.—From midnight to noon, wind increasing fast. Ship standing in to the N.E. and E. with wind as before, and N. by W. at noon, when she was in 30 fathoms water off St. John's, about Lat. 21°.10′ N., Long. 112°.48′ E. By 11 P.M. all the storm staysails blown away; ship hove-to with her head to the eastward.

"23*rd September*.—Storm increasing, topmasts blown away; ship becoming almost unmanageable. At a little after noon, when by indifferent observation the Lat. was 21°.15′ N., they let go the best bower anchor, to try to keep the ship's head to the sea; the wind is not marked, but seems to have been about E. by S. at noon.

"24*th September*.—Rolled away the mizenmast. Saw the Taya Islands at 6 A.M. Lat. at noon, 20°.15′ N."

"*Abridged Log of H. C. Ship* ROYAL GEORGE, *Captain* J. F. TIMMINS, *reduced to Civil Time.*

Royal George.

"The Royal George was, at noon, on the 22*nd September*, 1803, at anchor, with the Grand Ladrone bearing N. by E. ¾ E. three or four miles, and the Asses' Ears E. by N. Strong gales from N., with squalls and hazy weather. Lat. 21°.50′ N. P.M. Hard gales with squalls and fair weather. Wind N.N.E. at 5 P.M., and N.E. at 9. Midnight, severe gusts of wind with rain, and *a heavy swell from the north-east*.

On port-tack.

"23*rd September*.—A.M. Very hard gales with severe gusts of wind and rain; veering away cable. At 2 A.M. the wind marked E.N.E.; at 3, blowing very hard, cut the cable and hove-to (head to the S.E.) under bare poles. P.M. Wind east; strong gales with heavy squalls southerly; more moderate from 3 P.M.; at 5 P.M. St. John's bearing W.N.W. three or four leagues, in 20 fathoms water.

"24*th September*.—At 8 A.M. St. John's bearing N.W. six or seven leagues. Cow Cock N.E. by N. Wind E. by S.; making sail. The Alfred at daylight S. by E. five miles."

"*Abridged Log of H. C. Ship* ALFRED, *reduced to Civil Time.*

Alfred.

"At noon, 22*nd September*, had the Grand Ladrone bearing W. ½ S., Gap Rock S., and Asses' Ears due E. Observed that the swell was rising from the eastward. Wind marked N. At

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noon, working into the anchorage. P.M. Increasing breeze and cloudy weather, *with a long swell from the east.* At 4 P.M. anchored with Grand Ladrone bearing S., Gap Rock S. by E., Asses' Ears S. 65° E.; making all snug. At 11 P.M. wind increased to a hard gale N.N.E.; at midnight, drove.

"23*rd September.*—Gale still freshening, and ship driving at the rate of 2½ knots per hour; cut and stood to sea; hove-to; at 2 A.M. wind at N.E., and at 4 at E.N.E.; heavy gale with hard squalls and a confused sea at noon; at 2 P.M. E.S.E.; at 4 made some sail; at 7 P.M. E.S.E.

"24*th September.*—Royal George at daylight N. by W. Wind about E.S.E. and moderating."

"*Abridged Log of the* EARL OF CAMDEN, *Captain* DANCE, *reduced to Civil Time.*

Camden, in Lat. 15°.42′.

"20*th September,* 1803.—Noon Lat. 15°.42′ N., Long. 113°.41′ E.; hard gales with squally weather; wind N.N.E. at 1 P.M.; at 3, N. by E.; at 5, N. by W. to midnight. Ship trying to the N.E. by E., but making little or no way.

"21*st September.*—Constant hard gales and thick squally weather continue, with a high confused sea. 2 A.M. wind N.N.W.; at 3, N.W. by N.; at 9, N.W. by W. 11 A.M. N.W.; hove-to under close-reefed main-topsail. Lat. 15°.51′ N., Long. 115°.27′ E. *Bombay Castle* in company. P.M. Wind W.N.W.; hard squalls, thick weather, and rain throughout till midnight.

Wind veering.

"22*nd September.*—1 A.M. wind west; at noon, S.W. by S. Lat. 16°.17′ N., Long. 116°.23′ E. P.M. Wind S.W. by S. At 5 P.M. wind south; bore up; at 7 P.M. wind S.W.; at midnight, S.S.W.; weather moderating since noon.

Bore up.

"23*rd September.*—Monsoon weather. Wind from S. to S.S.W. Ship going four and five knots to the N. by W. Noon, Lat. by Obs. 17°.01′ N., Long. 114°.4′ E., from which time fine weather to China."

"*Abridged Log of the H. C. Ship* GANGES, *Captain* MOFFAT, *reduced to Civil Time.*

Ganges, in Lat. 16°.59′.

"20*th September,* 1803.—At noon, Lat. 16°.59′ N., Long. 114°.53′ E. Wind N.E. by N., hard gales, severe squalls, and thick weather till midnight; ship standing to the eastward under treble-reefed topsails.

"21*st September*.—At 1 A.M. the wind from the courses marked was N. ½ W. and N. by W.; at 3, continuing till noon, when veering to N.N.W. At noon, hove-to, with wind marked N.W. by N. At 1 P.M. under storm staysails; the Coutts bearing E.S.E. Lat. by indifferent observation and by double altitudes 16°.41′ N., Long. per Chron. 116°.31′ E. P.M. Wind N.W. by N., drawing round at times to W.N.W.; by midnight, wind increasing to a heavy storm. At 5 P.M. lost sight of the Coutts; staysails blowing to pieces between this time and midnight.

Hove-to, wind N.W.

Sails blowing away.

"22*nd September*.—At 6 A.M. wind about W., and at 9, W. S.W. At noon, wind about S.W. by W., blowing a violent hurricane. Ship lying-to under the storm-mizen only; weather so thick with drift and haze cannot see a ship's length a-head. Lat. double altitude 16°.17½′, Long. per Chron. 117°.17′. Find the drift made by timekeeper from noon yesterday, S.E. by E. ½ E., 50 miles. P.M. Wind marked as S.W., blowing a violent hurricane; ship lying-to under storm-mizen staysail, and falling off into the trough of a very heavy sea; made sail and bore away. At 4 P.M. steering N.W. to save the masts. At 5.30, the fore and main staysails blowing to atoms; got tarpaulins and boats' sails lashed in the weather fore-rigging to keep the ship off the wind, which however aided very little till 9 P.M., when the storm began to abate. Wind not marked. Ship running N.W. 27 miles till 8 P.M., then N. N.W. 14 miles till 10, and N. by W. 13 miles till midnight.

Wind veering.

Wind S.W.

"23*rd September*.—Wind more moderate, able to steer the ship with safety though rolling very deep. Steering N. 66½ miles till noon. Wind not marked at noon, but S.E. at 1 P.M. At noon, weather moderate, heavy confused sea, rolling gunwales in. Lat. 18°.58′ N., Long. by Chron. 117°.45′ E.; ship having made a course of N. ¾ E. 143 miles since yesterday. P.M. Wind S.E. and E.S.E. At 10 P.M. a four-knot breeze, the weather having cleared up. Noon, 24*th*, Lat. 20°.40′ N., Long. 117°.41′ E."

See diagram, page 176.

"*Abridged Log of the H. C. Ship* COUTTS, *Captain* TORIN, *reduced to Civil Time.*

"20*th September*, 1803.—Lat. 16°.57′ N.

"21*st September*.—P.M. Wind N.W. by N., hard gales, heavy squalls, and a large confused sea. 10 P.M. wind W. N.W., under foresail and mizen staysail, with head to the north.

Coutts, in Lat. 16°.57′.

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"22*nd September*.—At 5 A.M. wind W., hard squalls; at 6, W. S.W.; at 7, S. S.W. In the observations it is said, that at 9 A.M. the wind shifted to S.W., and moderated till near noon, when it came on to blow again very hard, with heavy squalls and rain. No observation or account marked in the log. 1 P.M. wind S. S.W., hard gale, increasing to a most violent typhoon, with rain, *lightning*, and a large confused sea. At 4 P.M. the wind S. S.W., weather fine. Shrouds giving way, bore away to save the masts; lost fore-topmast. 7 P.M. lost foresail and broached-to; at 8, main-topmast blew away; at 9, lost the main and mizen masts; at 10, wind marked as S.; at 11, S. by E.; lost the bowsprit.

Violent typhoon.

Lost main and mizen masts.

"23*rd September*.—2 A.M. lost the spare and stream anchors. At 3 the foremast fell into the waist; at daylight, moderate; clearing the wreck; and by noon kept on her course under a jury-mast. Lat. Obs. 18°.08′ N., Long. by Captain Torin's private journal, 117°.14′ E. Wind S. by W. at 1 P.M., when moderate breezes and fair weather. Wind S.S.E. at 10 P.M. till midnight.

"24*th September*.—At 8.30, saw two sail to the S., Camden and Bombay Castle. At noon, one ship (Camden) two miles astern. Lat. Obs. 18°.51′ N., Long. 116°.52′ E."

London's Typhoon, 1780.

The last figure will, I think, also serve to illustrate the nature of the gale which the London East Indian-man encountered on the 17th July, 1780. The London seems to have been in the northern semicircle of a hurricane, the centre of which passed to the southward of the ship about eight o'clock in the evening, as "the wind flew round from E.N.E. to the S.E." The London on this occasion was in a position somewhat similar to that in which ships are placed on leaving the Hoogley when a storm is crossing the Bay of Bengal, with its centre on the twentieth degree of latitude.

See p. 109.

The muddy state of the sea is here alluded to.

Such storms as that which the last diagram is intended to represent, may always be expected to

create a strong current from east to west along the coast of China, running with great strength between the Island of Hainan and the main land of China. That experienced by the London, is stated by her Commander to have carried him as far down along the coast as Hainan; but it is more probable that he mistook the land in sight, and that it was not Hainan which he saw.

"*Account of the Distress of the* LONDON *East Indiaman, 758 tons, in a Hurricane on the coast of China, taken from Captain* WEBB'S *Letter to the Directors of the Hon. East India Company.*

(*From the Annual Register.*)

"On our first arrival on the coast of China off Macao, 17th July, 1780, after my packet was delivered to the Supercargoes there, a typhoon came on, which had very nearly demolished us. At 4 P.M. our best bower cable parted, and the ship cast in shore; but by setting all the sail I could, I just weared her clear of the land, and as the wind was E.N.E., we stood out to the southward under our courses, and at 6 had the Ladrones bearing N.E. At 8, the wind flew round to S.E., and blew the hardest gale I ever rembember. We were then in 20 fathoms water, and not being able to make any more way out, our sails all blowing to pieces, we looked upon our destruction as inevitable without a particular act of Providence, for we were driving on a lee shore. At 12 at night, the wind flew to the south, its violence still continuing, and we found the ship shoaling her water, so that every soul on board was preparing for death. At daylight, we were in 12 fathoms water, with the sea, which was as much mud as water, breaking entirely over us. We then threw some of our guns overboard, and cut away the main and mizen masts, and by the time we had cleared them, we were in three fathoms water, the land only about a quarter of a mile distant. We immediately cut away the foreyard, and let go the sheet-anchor, which by the mercy of God brought us up; and as the ship touched the ground abaft, it eased her to the cable, or I am well assured the *Royal George's* anchors and cables would not have held her. We then instantly let go our spare anchor with a new cable, which parted as we were veering it out, so that we had no other left. About 9 A.M. the gale abated. In the evening we hove up our sheet-anchor,

London.

Wind E.N.E.

S.E.

South.

Sea muddy.

Let go anchor.

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when we found the cable stranded. What saved the ship was the having all our guns housed, her ports in, and top-gallant masts down on deck, before the gale came on. Our drift in the gale was amazing. I imagined it at first only about 50 miles, but to my astonishment when the gale was over, I found myself as low down as Hainan, within the westernmost island, about three leagues from the continent. I must have passed in the night quite close to a rock that bore S. by W. when the ship brought up. The Chinese told me, that every vessel that was that night at sea perished except mine; and that they had lost all their junks and boats round the whole country, and were certain not less than 100,000 people had perished in the storm."

Drift.

H. M. Ship Swift's Typhoon, 1797.

Another hurricane, of much the same character as the two preceding, was met by a ship called the Duke of Buccleuch, of 1182 tons, which sailed under convoy of H. M. ship Swift, from Macao, on the 15th June, 1797.

H. M. ship Swift foundered.

In this typhoon the Swift, with Captain Hayward and his crew, foundered. The log-book of the Buccleuch shows that they were scudding; and this is sufficient to explain why the wind changed with them through twenty points, since ships have been known to scud entirely round the compass in a whirlwind storm.

"*Narrative from Captain* LYNN'S *Star Tables.*

Duke of Buccleuch

"The Duke of Buccleuch (burden 1182 tons) sailed from China (Macao Roads) on the 15th June, 1797, in company with H. M. ship Swift, Captain Hayward, and a fleet of sixteen ships.

"*Sunday, 18th June.*—Moderate winds from S.S.E. to E.S.E., E., E.N.E., N.E. and N. at noon, with hazy weather throughout. Lat. Obs. 21°.58′ N., Long. by Chron. 116°.05′ E. Bar. 29·15, Ther. 83°.

"*Monday, 19th June.*—Commenced with increasing northerly wind and hazy weather. At 4 P.M. the wind increasing rapidly; in first and second reefs, handed the mainsail, struck the royal masts, and down top-gallant yards. At 7 P.M. wind N. E. by N., increasing to a heavy gale; handed the topsails. From 9 P.M. to midnight, the wind veering from N.E. by N. to N., N.W. to W.,

S.W. and S., increasing gradually the whole time, when its force was tremendous, and such as no sail I conceive could have endured. The foresail at this time blew out of the bolt-rope to atoms, and the ship tried under bare poles until daybreak, when the wind, having veered to the eastward of south, began to abate. No ship in sight since 3 A.M., when the Commodore, with whom we had been scudding, and whom we knew by his top-light, bore E.S.E. a quarter of a mile, and suddenly disappeared. The sea during the height of the gale (its surface being a continued spray), it was impossible to face; it searched through the weather ports, although well lined and secured; and in the working of the ship, through the weather-seams to such a degree as was incredible. Notwithstanding the force of the wind, the sea was not near so high as in common gales off the Cape of Good Hope, which I attribute to the partiality of the gale with regard to its extent, but perhaps to the extreme violence of the wind preventing the sea from forming a head. Bar. 29·00, Ther. 76°.

H. M. ship Swift, when last seen.

See pages 115-118.

"*Tuesday, 20th.*—Wind from S. by E. to S.E. by S., gradually abating to a moderate breeze, with fine weather at noon, when the Lat. Obs. was 22°.27′ N., and Long. by Chron. 117°.26′ E."

True Briton's Storm, 1809.

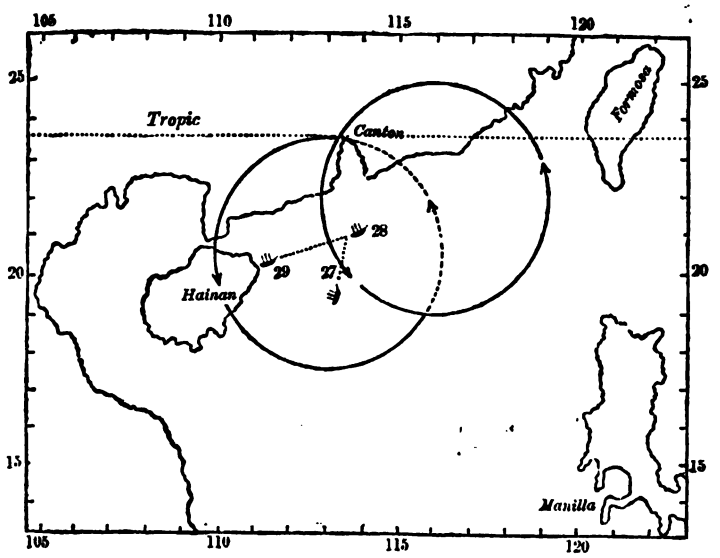
A storm encountered by the East India Company's ships True Briton, Scalesby Castle, Cumberland, and Neptune, in 1809, was one of those gales supposed to have been moving on a progression somewhat south of west, as in the next diagram.

The True Briton was never heard of again. I shall reprint the abridged account, taken from the log-book of the Scalesby Castle, together with an extract from a letter written in 1841. Mr. Piddington computes that the ships made 64 miles of northing during the storm, but no easting. On the contrary, they were drifted close to the shore of Hainan by the 30th of September, and perhaps the True Briton was there wrecked, if she did not founder in the vortex of the whirlwind.

True Briton lost.

Drift.

Now that the nature of these gales is understood,



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there can be no doubt that these four ships, which were on the port-tack, should have worn on the 28th of September. Sailing free with the north-west wind, and changing their course as the wind veered, they would have had a fair wind for Canton on the 30th of September, as shown by the dotted portion of the circle in the figure which is made to cut Hainan.

This storm may have passed over the Andaman Islands and the Bay of Bengal about the 3rd or 4th of October, 1809.

"*Abridged Log of the H. C. Ship* SCALESBY CASTLE, *Capt.* JOHN LOCH, *reduced to Civil Time.*

Scalesby Castle.

"*27th September,* 1809.—At noon, in Lat. 19°. 48′ N., Mean Long. 114°. 43′ E., light airs, and calm at midnight.

"*28th September.*—A.M. The weather with rather a threatening appearance, though the barometer has not fallen a great deal. At noon, it is again remarked the barometer fell in the last twelve hours from 29·85 to 29·50, but after the gale commenced it fell very fast. At noon, Lat. 20°.55′, Long. 114°. 54′ E., wind

Wind N.N.W.

N.N.W. P.M. N.N.W. to N. by E. at 10 P.M.; from noon the gale freshened with squalls; by 2 P.M. a fresh gale; 5 P.M. blowing very hard; and by 9, a most tremendous hurricane. At midnight, boats and sails blowing away; wind marked N.E. by N. CHAP. VIII.

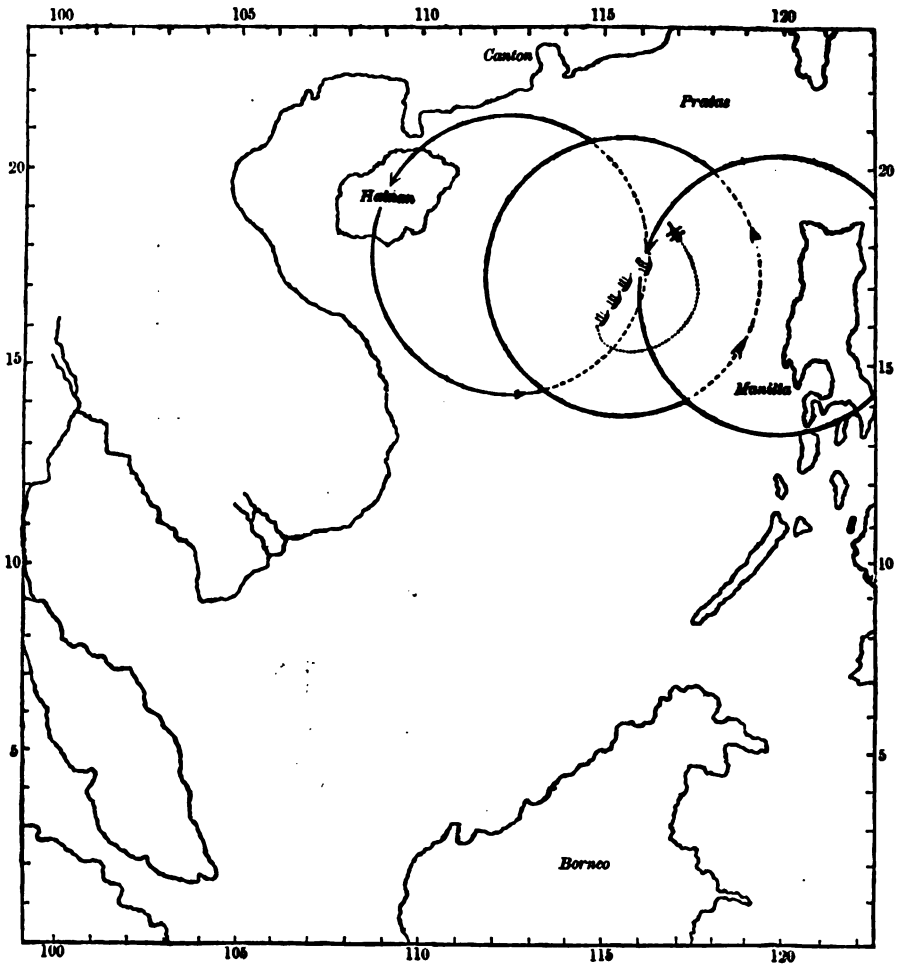
"29*th September*.—1 A.M. wind E. at E.S.E.; at noon, not marked. Of the barometer, it is said, 'The marine barometer began to fall fast after 4 P.M., but before that it was not very low; towards midnight it had fallen to 28·30, where it continued for nearly 24 hours: this was the lowest I ever saw the barometer.' The hardest of the gale was about 2 A.M. Noon, Lat. Acct. 20°.26′, Long. Acct. 114°.37′ E.; wind E.S.E., violent gale still continuing with a high sea, but began to moderate towards noon. At 5 P.M. saw a ship bearing E., with loss of mizenmast and foretopmast, which is supposed to be the Neptune; wind E.S.E. At midnight, hard squalls, ship lying-to; wind S.E. since 9 P.M. Bar. 28·30. Wind S.E.

"30*th September*.—Wind S.E. at daylight and till noon. The barometer began to rise after daylight. Noon, Lat. Acct. 20°.21′, Long. Chron. 111°.34′ E., showing a difference of 111 miles from the Long. by Acct.

"1*st October*.—No longitude is given."

Typhoon of 1810.

Another fleet of East India ships, consisting of the Armiston, Wexford, Alfred, Winchelsea, Elphinstone, Woodford, and Cuffnells, encountered a storm in the China Sea, which occurred, as in the year before, on the 28th and 29th September, 1810. This storm appears to have been moving very nearly from east to west, when it was met by the fleet sailing north. The centre of the storm was at the time on or about the seventeenth degree of north latitude, and it passed to the northward of the fleet. The Elphinstone seems to have suffered most from having made most northing, and being therefore nearer to the vortex than the other ships. The next figure will serve to represent the the track of the storm of September, 1810.



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"Log of the H. C. Ship WEXFORD, *Capt.* W. S. CLARKE, *reduced to Civil Time.*

Wexford.

"26th September, 1810.—Lat. 17°·13′ N., Long. not given, but nearly that of the fleet with which she was in company. 1 P.M. wind N.E. by N., heavy clouds, squally, and rain. 2 P.M. thickening sky to the east; squally and unsettled from this to sunset, when it began to disperse. 8 P.M. N.E.; lightning and thunder to the northward; the night fine and moderate.

Wind easterly;

"27th September.—A.M. Easterly wind, with hazy weather, E. by N. At 7, E.N.E., fleet steady to the northward, against

a heavy head swell, which occasioned them to pitch deep at times. Noon, Lat. 17°.41′ N., Long. (of the fleet) about 115°.11′ E. P.M. Wind E.N.E., hazy weather. 5, N.E. by N., blowing fresh, with small rain; preparing for a gale; *heavy head sea.* swell from north.

"28*th September.*—2 A.M. wind N. by E., squally and increasing. Noon, N. by W. Lat. 2 Alt. 17°.6′ N., Long. 115°.58′ E.; fleet much scattered. P.M. Wind N.; 3 P.M. hove-to under storm-staysails; 5, wind N.N.W., hard gale, with very hard squalls till midnight, when about N. by W. Wind north.

"29*th September.*—2 A.M. N.W. by N.; 4, N.W. by W.; 5, S.W.; and at noon, S.S.W.; heavy seas breaking over the ship from daylight till noon, when it blew a perfect hurricane. P.M. Wind south; hove-to under trysail; wind about S. till midnight, when moderating. Wind south.

"30*th September.*—Bore up, and out all reefs at daylight. Noon, Lat. 18°.24′ N."

"*Abridged Log of the H. C. Ship* ELPHINSTONE, *Capt.* M. CRAIG, *reduced to Civil Time.*

"27*th September*, 1810.—Noon, Lat. 17°.41′ N., Long. 115°.6′ E. P.M. Fine and variable from E.N.E to N.N.E., till midnight. Elphinstone.

"28*th September.*—5 A.M. N. by E., preparing for bad weather. Noon, Lat. 17°.17′ N., Long. Chron. 115°.53′ E. P.M. Strong gales N. by E., with hard squalls. 3 P.M. Wind N.W. by N. At 5, N., and at 10 N.by W.

"29*th September.*—1 A.M. wind N.N.W.; at 3, W.N.W.; at 5, S.S.W.; at 6, S.; at 9, S. by W.; at 6 A.M. bore up under fore-staysail to look for the Commodore, and ran north five miles. At 8, saw two ships to the S.W. lying-to; hove-to again. At 9.30, one bore up across us; gale much increased since daylight. At 10, bore up again, steering N. 10½ miles. At 11, fore-staysail blew to pieces; sea prodigiously high, rapid, and violent; hove-to again, several seas breaking over the ship; set mizen storm-staysail, which blew to pieces; much water between decks. Noon, water increasing fast; set the weather clue of the fore-sail to wear, but it blew to pieces. Lat. by log worked back from 30th, 18°.4′, Long. 115°.22′ E. P.M. An inconceivable increase in the fury of the storm and violence of the waves. Ship almost water-logged, apparently settling fast. At 1.30, cut away the mizenmast; but the ship not wearing, yardarms in the water, and being deadly water-logged, cut away the mainmast Bore up and ran north. Sails blowing away. Yardarms in the water.

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at a quarter before two, when she paid off, though she heeled gunwales in; hove the starboard upper guns overboard. All hands at the pumps, steering N.E. At 10 P.M. wind S. by E.

"*30th September.*—At 5 A.M. steered north for an hour, but hauled up again to N.E., moderating gradually. Noon, Lat. 19°.05′ N., Long. Chron. 116°.26′ E."

After this date the ship had fine weather, like the rest of the fleet.

"*Abridged Log of the H. C. Ship* WINCHELSEA, *Captain the Honourable* HUGH LINDSAY, *reduced to Civil Time.*

Winchelsea.

"*26th September,* 1810.—Lat. 17°.33′ N., Long. 115°.16′ E., variable winds, N.E. till midnight.

"*27th September.*—6 A.M. E.N.E. light winds, steering to the northward. Lat. 17°.47′ N., Long. 115°.14′ E. Bar. 29·92, Ther. 81°. P.M. E.N.E., fine weather, but increasing breeze N.E. At 5 P.M. N.E. by N.; at 9, high sea from the N.E.

"*28th September.*—2 A.M. N.N.E. increasing, making all preparations for bad weather. Noon, Lat. 17°.30′ N., Long. 116° E. Bar. at 8 A.M. 29·80, noon, 29·70; Ther. 80°. 1 P.M. hove-to, wind about N.N.W. but not marked, blowing excessively hard. Bar. 11 P.M. 29·20.

Bearing up too soon.

"*29th September.*—4 A.M. west; 6 A.M. S.W., bore up, and ran 36½ miles to the N.N.W. and N. by W.; hove-to again at 10. Noon, blowing excessively hard from S. Lat. Account 17°.36′ N., Long. by Account and D. R. 116°.11 E. Bar. 10 A.M. 29·23, noon, 29·36. 5 P.M. wind S. by E., gale moderating and sea much fallen. At 8, S.S.E. 6.10 P.M. Bar. 29·65. Bore up at 7 P.M., and ran six and seven knots till midnight, steering N. by W.

"*30th September.*—By midnight fair; at noon, fine, and had run from 7 P.M. on the 29th, to noon 30th, 119 miles N. by W., and N. by W. ½ W. Lat. Observed 19°.54′ N., Long. Chro. 116°.00′ E. Bar. 6 A.M. 29·80, noon, 29·90.

The Elphinstone and Winchelsea had sights on the 30th of September, and Mr. Piddington says that by working back to noon on the 29th, the place of the Elphinstone would be about 22 miles N.W. of the Winchelsea, and that it is just at this time the log-

book records "the inconceivable increase in the fury of the storm;" and he adds, that he need not say how important this lesson is to the seaman, teaching him not to be tempted by a fair wind to bear up too soon.

I have marked on the diagram the track which these ships might have steered, in order, in the first instance, to have avoided the storm's greatest force, and, after the gale had passed by, to have sailed to Canton with yards squared.

Theban's storm, Sept. 1812.

H. M. ship Theban, having five East India Company's ships under convoy, experienced a hurricane in the China Sea on the 8th and 9th September, 1812, the H. C. ship Glatton being at the time about three degrees to the southward of the fleet.

By the Elphinstone's log-book, the fleet was in Lat. 16°.14′ N., Long. 114°.16′ E., on the 7th September, making preparations for bad weather.

Sept. 7,	1 P.M. the wind was	N.E.
„	4	N.
„	midnight, increasing to a hard gale, ..	N.W. by N.
„ 8,	3 A.M.	W. by S.
„	5	W. by N.
„	11	W.N.W.
„	1 P.M.	W. by N.
„	11	W. by S.
„	midnight, blowing excessively hard in gusts	W.S.W.
„ 9,	1 A.M. hard gale, and heavy gusts until 8 A.M., moderating, and bore up ..	S.W. by W.
„	P.M. moderate	S.W. by W.

The last figure will serve also to represent this storm, by supposing it to be transferred one degree more to the southward, for there is little other difference between them.

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The Glatton, in Lat. 13°.18′ N., Long. 114°.32′ E., had strong gales at west with a heavy confused sea on the 8th. On the afternoon of the 9th, the wind was W.S.W. and moderate, but still that vessel had the "heavy confused sea."

The fall and rise of the Barometer on board the Wexford was—

Sept. 6,	noon,	29·60,	wind W., squalls and rain.
„ 7,	noon,	29·50,	E., squally, unsettled, latterly N.E.
„	6, P.M.	29·45,	N.E. and N.
„	midnight,	29·40,	N.W. gusts.
„ 8,	8 A.M.	29·30,	gale N.W.
„	noon,	29·20	
„	6 P.M.	29·15	
„	midnight,	29·15	
„ 9,	8 A.M.	29·20	
„	noon,	29·35	
„	8 P.M.	29·60	

Warren Hastings' gale, Oct. 1819.

The East India Company's ship Warren Hastings experienced a severe gale at the end of October, 1819, in Lat. 20° N., Long. 119° E. On the 28th of October, in Lat. 19°.52′ N., Long. 119° E., the gale veered from N.N.E. to N.N.W. Next day the wind was N.W.; and on the 30th of October it shifted round to S.E. and S.W.

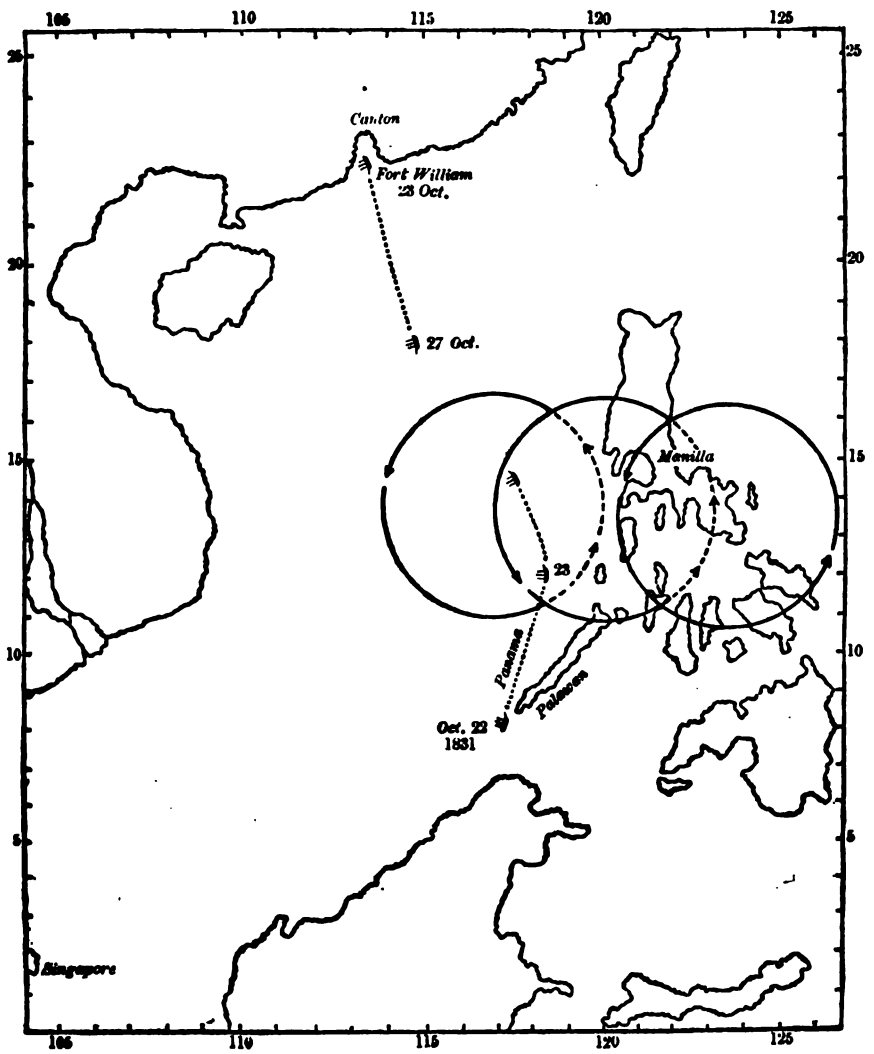
Mr. Piddington thinks this gale must have come from the Pacific Ocean, and that it was moving W. by N. when the Warren Hastings met it. No observations on the fall of the barometer have been obtained.

Manilla Typhoon, 1831.

The typhoon experienced by H.M. ship Crocodile on the 23rd and 24th October, 1831, in the harbour of Manilla, has received further illustration from the publication of an extract from the private journal of

the Master of the ship Panama, which I shall reprint below. An extract from the Crocodile's log-book has been already published.*

At Manilla this typhoon set in northerly at sunset on the 23rd, and on the morning of the 24th it shifted to N.E.



*Law of Storms, page 284. 2nd Ed.

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The ship Fort William sailed from Canton on the 23rd, the day this typhoon occurred at Manilla. On the afternoon of the 24th of October, the Fort William met a gale blowing at N.E.

On the 25th she lost her mainmast.

On the 26th she lost her foremast.

On the 27th she had again fine weather, and I have marked her place for that day.

Unfortunately the direction of the wind on the 25th and 26th is not given; nor is there any record of the barometer. Thus it is impossible satisfactorily to decide whether this vessel was dismasted in the Manilla typhoon or in another gale.

The N.E. monsoon set in at Canton in 1831 between the 1st and 14th of October.

"*Extract from the Private Journal of* W. F. GRISWOLD, ESQ., *Master of the Ship* PANAMA, *on a voyage to Calcutta, October,* 1831.

Ship Panama.

"*23rd October, Nautical Time.*—Lat. 9°.17′ N., Long. 117°.16′ E. Wind came out at southward and continued until 10 P.M., then died away, and commenced from the northward with a heavy head sea. Forenoon, breeze from N.W. and clear weather. Lat. 9°.45′ N., Long. 117°.25′ E.

Swell from northward.

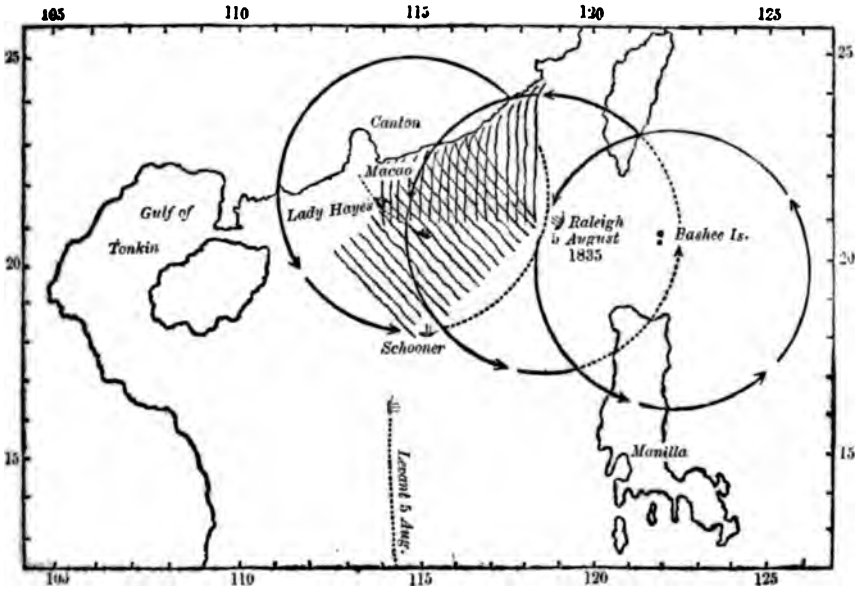
"*24th October.*—Pleasant breezes from N.W., and hazy, steady weather. A sea rolling from the northward. I suppose there has been a gale in the China Sea which has not yet reached us. Evening, wind rapidly increasing, and Bar. falling from 29·75 to 29·40. Midnight, reefed topsails. 9 A.M. double-reefed ditto. Bar. 29·20. Ends with tremendous gale from the westward, and heavy sea. Bar. 29·10. Lat. 11°.15′ N., Long. 118°.20′ E.

"*25th October.*—Heavy gale W.S.W. Bar. 29·05. Gale hauling to the southward; evening, more moderate. Made a little sail; wind at 7 P.M. from S.W.; 11 P.M. from southward. In the morning at 5 o'clock the wind came out at S.E. (Bar. 29·10), and blew a perfect hurricane. Hove-to under mizen staysail. Bar. at 1 P.M. 29·05; 4 P.M. 29·00; 7 A.M. 29·10; 8 A.M. 29·20."

The Raleigh's Typhoon.

Raleigh's typhoon, 1835.

An extract from the log-book of H.M. ship Raleigh was published in the Law of Storms,* but only a very imperfect diagram of the typhoon in which that vessel was upset on the 5th of August, 1835, was given. Mr. Redfield having published further information on this typhoon, I have placed here another diagram, to show that it came from the Pacific Ocean and passed over Macao.



***"Extract from a Private Letter on the* LADY HAYES, *which left Macao a day or two before the Storm, and returned to Kumsingmoon after the Gale; published by* MR. REDFIELD.**

Lady Hayes.

"Early on the morning of *August 5th*, we observed indications of bad weather. At 10 A.M. the wind freshened a little from the same quarter it had been in for the last twenty-four hours, viz., *north*; so we thought it best to turn her head back again to look for shelter, fancying ourselves to be about thirty miles off the land.

* Page 278, 2nd Edition.

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We carried a press of sail until noon, when we found we had too great a distance to run before we could get into shelter, and expecting it would get so thick that we could not see our way; so we turned her head to sea, and clapped on as much sail as she could stagger under, *steering S.E. by E. The wind being then at north we were desirous of getting as far off the land as possible, expecting the wind round to the eastward,* THERE BEING A MOST TREMENDOUS SWELL *from that quarter.* At 4 P.M. it was blowing in severe gusts, and we shipping a good deal of water, and the ship becoming unmanageable. About 8.30 the *wind began to veer to the west,* but continued to blow as hard as ever till midnight, *when it drew round to south,* and moderated a little. It continued to blow hard from that quarter until noon of the 6th, when it moderated fast, and we began bending other sails in room of those that were split. When the gale commenced, which we consider it did *at* 1 P.M. *on the 5th,* we were about twenty miles east of the Lema; where we were when it ended it is hard to say, as we saw nothing till the morning of the 7th, when we made Mondego Island. We hardly think we could have had the gale so heavy as those inside; and what is most extraordinary, the wind with them *veered to the eastward round to south,* but with us it veered to the *westward round to south.* It was fortunate for us that it veered to the westward; for had it veered to eastward we should most likely have been driven on shore among the islands, as we could not have been more than fifty miles off the land (?) at 8 P.M. on the 6th."

Wind from north, swell from east.

I have endeavoured in the diagram to show why the ship Lady Hayes "*had the swell from the east, the wind being then at north.*" When this ship ran to the south-east and had the wind veering to west, most probably a north-east swell would get up which would reach the schooner marked in the figure just within the influence of the storm. The ship Levant, at noon on the 5th August, was in Lat. 15°.55′N., Long. 113°.24′ E., with the wind at S.W. and carrying royals and studding-sails; during the night it became squally. At 11 A.M. of the 6th the Levant was under reduced sail with two reefs in the topsail, with the wind S. S.W.

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The Raleigh was upset at 9.30 A.M. On the afternoon of the 5th August, in the log-book of the Levant *a heavy sea* is noted. As the storm advanced, a swell rolling from the N.N.E. would reach that ship; and we may conclude that she would gradually have a head-sea rolling from the north, changing to the west.

By inspecting the figure it will be seen, that a ship in the position of the Lady Hayes, by scudding with the wind from north and swell from east, would be in the trough of the sea. By bringing the wind on the starboard-quarter, the heaviest sea would be on the port-quarter, with an aft swell from the north-east getting up.

Storm current.

A storm like this might be expected to draw with it a mass of water from the Pacific, owing to diminished atmospheric pressure, which alone would be sufficient to create a current round the north and west sides of the China Sea and through the Gulf of Tonkin. When the east wind of the storm blows at the same time on the coast of China, a very strong current running to the west and round the Gulf of Tonkin may be expected.

Typhoon of 1832.

August 3, 1832.

Mr. Redfield has published an account of a typhoon which passed over Macao on the 3rd August, 1832, in which the wind changed suddenly from north to south. At Macao,

The Bar. on the	2nd Aug.	at 8 A.M.	stood at	29·68
,,	,,	at 8 P.M.	,,	29·34
,,	3rd Aug.	at 8 A.M.	,,	29·34
,,	,,	at 5 P.M.	,,	27·88

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This is an example of the rapid fall of the barometer at the centre of a whirlwind storm. The detailed account of this storm states, that after the wind changed to the southward "the quicksilver rose at the rate of ·3 of an inch per half hour."

The S.W. monsoon was blowing at this time, and did not change to N.E. at Canton until the 25th of September.

Atmospheric pressure.

I shall reprint here an abstract from the log-book of the barque Ariel in a severe storm, reduced to *civil* time. It is stated that the barometer gave no indication of the approach of this storm, and that it stood high even when the ship was reduced to bare poles, which is remarkable. But on examining the fall and rise as given in the log-book, it will be seen that the barometer rose after the gale to 31·30, having been down to 29·80. This is a difference of an inch and a half of the mercurial column during the passage of the whirlwind storm. The height of the barometer on the 15th and 16th of November is not stated.

The N.E. monsoon was blowing hard at the time. This might be expected to augment the force of the wind of the whirlwind in that quarter of its circuit in which it would blow from the N.E., and it may have been the means of augmenting the pressure of the atmospheric column. It was ascertained that the barometer was in good order at the time, and remained so eighteen months after the typhoon. I have seen at Bermuda the barometer rise in a remarkable manner, on the setting in of hard blowing N.N.E. winds, which blew without veering.

"*Abstract of the Log of the* ARIEL, *Captain* BURT, *reduced to Civil Time.*

"15*th November*, 1837.—The barque Ariel, bound to China, was at noon in Lat. 15°.1′ N., Long. per Chron. 116°.15′ E., with fresh gales from N.N.E., hazy weather and heavy sea on; having increased to this from a steady breeze at midnight of the 14th; vessel standing to the E. by S., going 7 and 8 knots. P.M. Wind marked N.E., and to 10 P.M., standing to the E.; gale increasing rapidly to midnight. At 10, wore to the northward. Ariel.

"16*th November*.—Wind N.E. to noon; heavy cross sea running very high. At 8, wore to the E.; lost mizen-topmast. Noon, hard gales N., mountainous sea. Lat. Obs. 15°.8′ N., Long. 116°.45′. Wind about N.N.E. P.M. Wind N.N.E. to midnight.

"17*th November*.—Gale still increasing, and every appearance of a dreadful typhoon. Barometer still high at 30·10, and Sympiesometer as usual. Daylight, wind hauled to the N. in a tremendous squall. 10, blowing awfully hard, and sea beyond description. Noon, typhoon blowing dreadfully; wind N.W., and sea like pyramids all round; could not look to windward for the wind, rain, and sea blowing on board; the ship frequently lurching, half the main rigging and oftentimes the bowsprit under water. Barometer fell to 29·80. P.M. Wind W., a most dreadful typhoon blowing, ship in a most perilous situation. At 2, wind N.W., and then for two hours till 4 P.M. I really cannot describe the scene; the ship rising with difficulty to several of the lurches; got all ready to cut away the masts. At 4 P.M. the ship lay over so much that half the lower yards were in the water; saw that she was settling down, and upon her beam ends, the water being up to her main hatch. Cut away the mainmast, which carried away the mizenmast and foretopmast with it. Ship righted, three feet water in the hold, sea breaking over us in all quarters. At (blank in MS.) P.M. the barometer began to rise, and was at 29·90, and at 6 P.M. at 30·10; during the whole of the night it still blew tremendously, wind veering from N.W. to W.S.W. and S., with constant rain. Bar. 30·10. Bar. lowest, 29·80. Bar. rising, 29·90, 30·10.

"18*th November*.—At daylight still blowing hard, and an awful sea running. At 10, wind hauled to S.E., when it began to moderate. Noon, strong gales from the S.E., and sea running, but every appearance of the gale breaking up. Set storm fore-stay-sail, and hauled up to N., supposing we were well to the west

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of the Scarborough Shoal, in the neighbourhood of which we must have been all night.

During this awful typhoon, the barometer gave no indication of its approach, for we were under bare poles a long time before it fell, it being all the time at 30·10, then it fell to 29·80, and again it rose to 30·10, 15, 25, to 35, still gale blowing as hard as ever, and at noon it was 30·90. No observation. P.M. Strong gales from S.E., hauling to E. At 3 P.M. gale again increasing, with threatening appearance all round. 3.10. Saw the breakers on the Scarborough Shoal one or two miles off, bearing N.W.byN. to E.N.E., sea breaking mountains high upon it; bore up to the W. S.W. to clear it. 6 P.M. severe gales from the N.N.E., with dreadful weather, sea washing over us in all quarters. At 10, hove-to, vessel being very uneasy, and at times severely struck by the sea. Midnight, very severe gales from the northward, with continued rain and an awful sea.

Bar. 30·35, 30·30.

"19*th November*.—Daylight, the same severe gales and dreadful weather, with constant rain, and so thick, we could not see the length of the ship. Wind N. N.W., and tremendous sea. Noon, moderating, and wind hauling to the N.N.E. From noon 18th, barometer *rose* from 30·35 to 31·30. P.M. Wind marked N.E., strong gales, constant rain, and awful sea, which we were shipping all over us. After consultation with the officers, bore up for Singapore at 3 P.M., running west till midnight.

31·30.

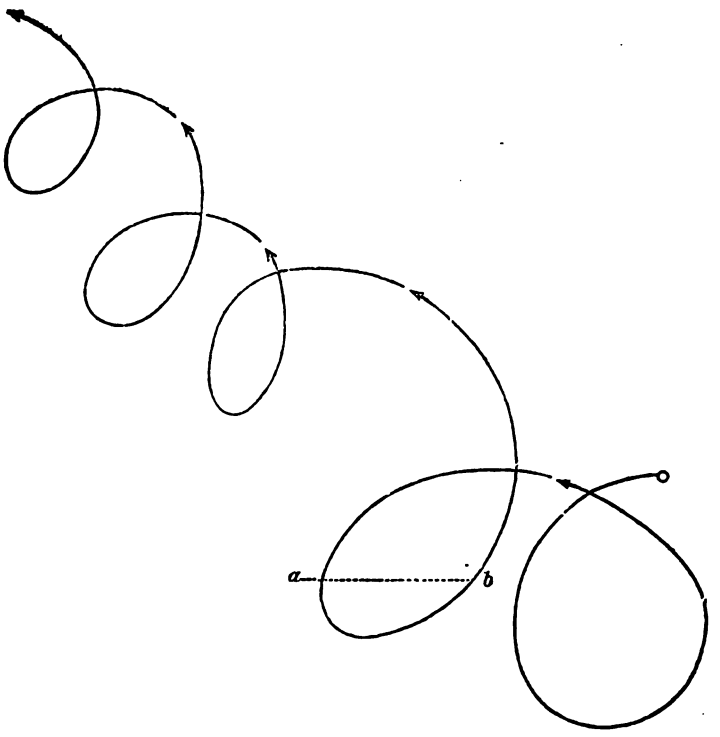
"20*th November*.—Midnight, gale increasing again, and heavy seas breaking fore and aft; hove-to again till daylight, when severe gales from N. N.W.; bore-up and scudded under the storm staysail. Noon, more moderate, but blowing hard with an awful sea. P.M. Strong gales from N.E., with heavy rain; sea falling a little. Midnight, more moderate.

"21*st November*.—Noon, fresh breezes from N.E. to midnight, with dark, squally weather, but decreasing wind and sea.

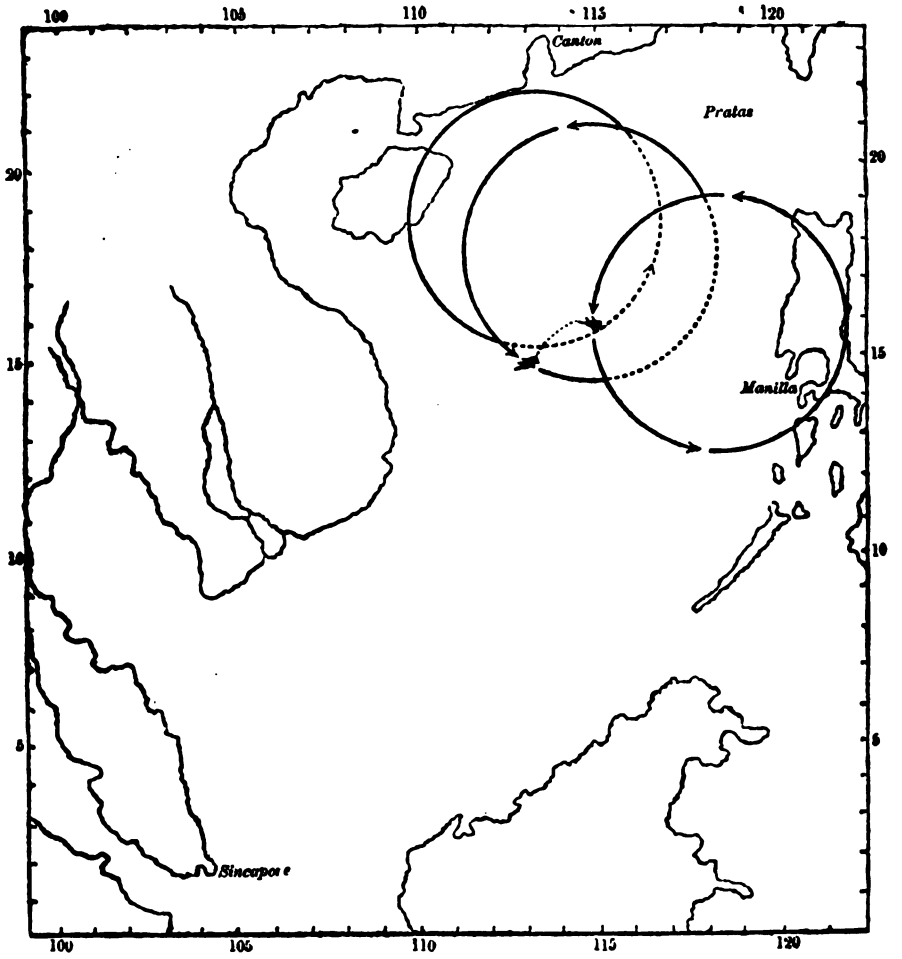
"22*nd November*.—Decreasing to light breezes from E.N.E., and fine; a long heavy turbulent sea on. Noon, light easterly winds and a heavy sea. Lat.12°.38′ N., Long. 112°.5′ E."

Progressive Whirlwinds not Circles.

I have already stated in Chapter I. that the circle will only correctly represent a whirlwind when stationary, and that in the progressive whirlwind the figure



would become cycloidal, and the degree of curvature would depend upon the rate of progress of the storm. Whilst attempting to lay down a storm's track, a wrong judgment may be formed, if data be rejected on account of its not conforming to a figure exactly circular. I here reverse, as for the *northern* hemisphere, the track laid down by Mr. Piddington, which the Charles Heddle actually sailed over in the *southern* hemisphere, in illustration of what I have just stated. For example, at the point *a* the wind would be north; at the point *b* (due east of the point *a*) it would be south-west. Circles, nevertheless, have been found the most convenient figures, in endeavouring to explain the nature of storms.



CHAP. VIII.

Barque Black Nymph.

I shall conclude this chapter on the gales of the China Sea with Captain Hall's interesting account of the way in which he avoided falling into the heart of one of these gales. I have taken this account from the "Nautical Magazine," a periodical publication which has largely contributed towards advancing our knowledge of the law of storms. The circles in the above diagram are intended to represent that gale

coming from the south-eastward. The ship Black Nymph is marked as on the starboard-tack, receiving the wind in the first instance at north, and afterwards, as the storm advanced and the ship went a little a-head, receiving the wind at W.N.W. The dotted portion of the third circle will show how the ship at last would have the wind W.S.W.

Captain Hall says:—"When three or four days' sail from Macao, about noon, I observed a most wild and uncommon looking halo round the sun. Next day set in with light squalls, smooth water, but strong ripples. The afternoon was remarkably fine; but, casting my eye on the barometer, I saw it had fallen considerably since noon. I thought at first some one had meddled with it, though, looking again half an hour afterwards, I was convinced it was falling rapidly. Still the weather seemed very fine, and I thought it strange; but I was inclined to trust to my old friend, which, by its timely warnings, had saved me many a sail and spar before, and at other times had often enabled me to carry on through an uncomfortable looking night. On this occasion it proved itself worthy of trust, and I should have had cause of regret had I neglected its warning, and trusted to appearances only. About 3 P.M. the barometer still falling, though the weather continued fine, I ordered the crew, employed in cleansing the ship and preparing for harbour, to strike top-gallantmasts and yards, mizen-top-gallant-mast and jib-boom, the sails and rigging of which I put *below*, and, indeed, divested the rigging aloft of all top-hamper, and everything that could be spared. Secured sails and hatches, close-reefed the topsails, and boats hoisted on board, and well secured.

Weather fine, but Bar. falling.

Still falling, and weather fine.

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"Done beforehand, all was done quickly and well. I dare say *Jack* thought it funny work making all this preparation on a fine afternoon; and some of them looked about, weatherwise, to divine the reason: but in a few hours the most incredulous were satisfied with the prudence of the operations. Quiet succeeded to bustle; and the barometer still falling, I said to myself, 'Now in reality is coming one of these typhoons;' and having previously been led to pay some attention to the subject, I looked to its approach with a mingled feeling of apprehension and curiosity.

Still falling.

A bank rising in the S.E.

"Towards evening I observed a bank in the S.E. Night closed in, and the water continued smooth; but the sky looked wildish, the scud coming from the N.E., the wind from *north*. I was much interested in watching for the *commencement* of the gale, which I now felt sure was coming; and considering the theory to be correct, it would point out my position with respect to its centre.

Wind north.

"That bank in the S.E. must have been the meteor approaching us, the N.E. scud the outer *north-west portion of it;* and when at night a strong gale came on about N. or N.N.W., I felt certain we were on its western and southern verge. It rapidly increased in violence, but I was pleased to see the wind veering to the N.W., as it convinced me that I had put the ship on the right tack, namely, *on the starboard tack*, standing of course to the S.W.

N.N.W.

N.W.

"From 10 A.M. to 3 P.M. it blew with great violence, but the ship, being well prepared, rode comparatively easy. The barometer was now very low, the wind about W.N.W., the centre of the storm passing doubtless to the northward of us, and to which we might have been

W.N.W.

very near, had we in the first part put the ship on the larboard tack, and stood to the north-east, and towards the centre, instead of on the starboard tack and to the south-west, the opposite direction. CHAP. VIII.

"About 5 P.M. wind at W. S.W., sensibly decreasing, the barometer rising. At 6, fresh gale, made sail to keep ship steady; a very great sea on, and towards midnight it became a moderate gale. The wind having now become S.W. to S.S.W., the ship broke off to S.E. Thinking it a pity to be lying so far out of our course, I wore to N.W, and made sail; but in less than two hours heavy gusts came on, and the barometer began again to fall. I now thought, of course, we were approaching the storm again; and, doubtless, the theory is not mere speculation. I wore again to the S.E.; and to show more clearly how great a difference a very short distance nearer to, or further from these storms makes, the weather rapidly improved. The next morning it was fine and moderate, and the wind became S.E, with a heavy running westerly swell. Until the afternoon there was a dark, wild appearance in the westward, which seemed to me another proof that it was the meteor which had the day before appeared in the S.E., and whose course had been from S.E. to N.W., passing a little northward of our position.

Wind W.S.W.

S.W. S.S.W.

Wore, and followed the gale.

Wore again, and kept from it.

"When we arrived at Hong Kong, two or three days afterwards, we found they had had a gale, but not very violent; for the storm was evidently of small extent, and its centre lay between the ship and Hong Kong, through which centre I might have had the pleasure of passing, if, regardless of the indications of the barometer, and the results of the scientific comparison of the data of other storms, I had been eager merely to keep

CHAP. VIII.

on the tack, the larboard, nearest my course, heading to the north-east, instead of standing to the south-west. I may also add, that though the storm-wave might have been carrying me to the westward, the storm-current certainly swept me to the southward, out of the course of the storm.

Storm current.

"I regret that, being just now at a distance from home, I cannot avail myself of my papers, to give you the exact particulars of changes of the wind, barometer, &c.; but this short practical study of a rotatory storm so impressed the principal features of it on my memory, that you may depend on the general accuracy of this rough sketch.

(Signed) "JOHN VINE HALL."

Mr. Piddington is zealously and successfully pursuing his investigations, into the nature and tracks of storms in the Indian and China Seas, and he is extending his inquiries to extra-tropical gales. The following extract from a Calcutta newspaper was received whilst this volume was printing:—

See fig. page 111.

"In our paper of the 16th October (1848), when announcing the progress and track of the Cyclone, which committed such fearful mischief from the 11th to the 14th of that month in the bay, we anticipated that some of the ships might find time *to cross in front of its track*. Two vessels, the Futtle Rozack and Easurain, certainly did so; and we have been favoured with an extract of a letter from Aden, from Captain Andrew, of the ship Futtle Rozack, showing that, for commanders who understood their position, even when hampered between the advancing Cyclone, the Sand Heads to the north, and the land of Point Palmiras to the west, the course we pointed out was the one which might be safely taken. The extract is as follows:—

"'I have once more to be thankful for the information I have derived from the Law of Storms. This ship left Calcutta very

deep, and after going through that fearful Cyclone (for fearful it appears to have been), I have lost not a rope-yarn, except *an old worn-out jollyboat*. I send a copy of my log, and shall be too happy if it adds anything to the furtherance of this beautiful science.

"'I do not think we were within the influence of the revolving disk until we had the wind from N.N.E; consequently I do not think by any manœuvre I could have got better weather. I made a sort of diagram, and made the course of the Cyclone about N.W. by W. ½ W.; but a single ship cannot come very near the truth. I made the centre at the time we had it hardest, about 100 miles from us.'"

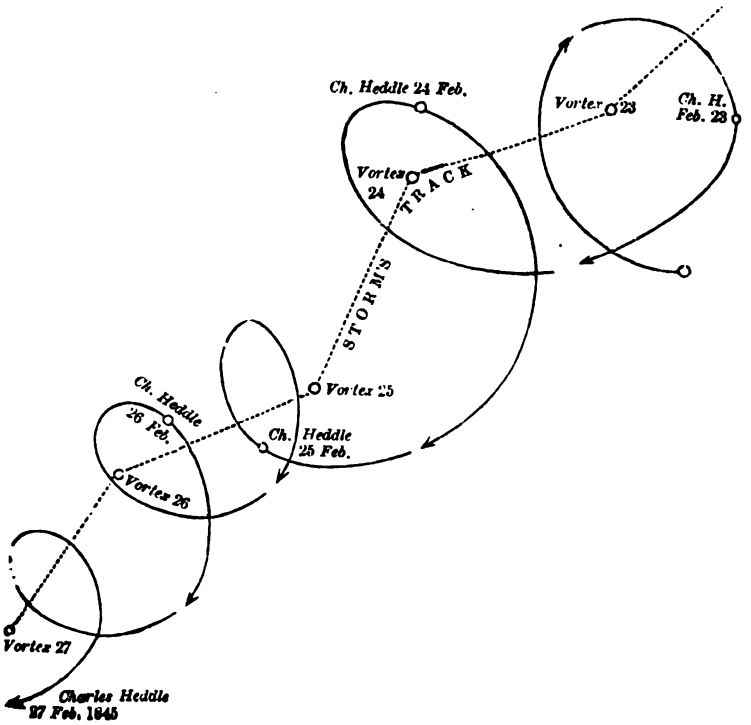
Mr. Piddington adds, that Captain Andrews had correctly estimated the direction in which this storm was moving to within half a point.

CHAPTER IX.

TROPICAL STORMS IN THE SOUTHERN HEMISPHERE.

CHAP. IX.

THAT storms revolve in a contrary direction in the southern hemisphere, to that in which they revolve in the northern hemisphere, has received a very curious illustration, from the fact of a vessel called the Charles Heddle scudding for five days in a progressive whirlwind south of the Equator.



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The figure given of the track the Charles Heddle sailed over, was made by Mr. Piddington, but is reduced to half his scale. It will be found in the Journal of the Asiatic Society.

The Charles Heddle is a brig belonging to the Island of Mauritius, commanded by Captain Fink, an able seaman. The brig had been originally built as a slaver, and is a very fast sailer.

A copy of the log-book of the Charles Heddle, which was in French, was sent by the Master Attendant at Mauritius, Captain Royer, to Mr. Piddington, at Calcutta; and Mr. Piddington having procured the log-books of several other vessels which encountered the same storm, has been enabled to draw up a very instructive memoir.

The Charles Heddle sailed on the 21st February, 1845, from the Mauritius, on a course nearly due north. Soon afterwards the weather became thick all round. At night the sea and wind gradually increased, and the vessel began to labour greatly. At 9.30 P.M., the wind being at the time S.E., and having begun to blow very hard, the mainyard went in two in the slings. The mizen and jib were taken in, and the vessel put before the wind, scudding under her foresail, fore-topsail, and fore-topmast-staysail, until daylight. The main-topsail-yard and the topgallant-yard were then struck. At noon the foresail was close-reefed, and the brig scudded to the N.N.W. before the wind at S.S.E. She was now within the compass of a whirlwind, in the *southern* hemisphere, in Lat. 16°.42′ S., and Long. 57°.45′ E. Scudding round in this whirlwind, the wind from S.S.E. became S., and continued to the brig, constantly veering as she sailed round and round. Thus

See next following diagram, page 213.

See fig. page 206.

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in the log-book it is next recorded that she scudded N., then to N.N.E., next N.E.; her course changing to E.N.E., to E., to E.S.E., to S.E., to S.S.E., and then to S., when the wind in the log-book is marked at N. The log-book goes on to show that the Charles Heddle's course was changed from S. to S.W., to W.S.W, to W., to W.N.W., to N.W., and to N.N.W., the wind throughout being marked in the opposite quarter, as she was scudding before it at twelve knots an hour. Thus she completed her first entire revolution round the vortex of the storm. By this time she was reduced to bare poles, for her sails had blown away. Scudding under bare poles, she continued changing her course from N.N.W. to N., to N.N.E., to N.E., to E.N.E., and round again through all the points of the compass, to N.N.W., being marked nearly throughout as running at the rate of eleven knots, and the wind always recorded as being exactly in the opposite point to the course she was scudding. In making this circuit, it is stated in the columns of remarks that she broached-to several times.

In this manner did the Charles Heddle make five complete circuits, wanting only four points of the compass round the vortex of a storm, by steering always before the wind.

The extract from the log-book being a remarkable and valuable document, I shall reprint it here. By reference to this extract, it will be observed that the periods occupied in sailing round and round the vortex were unequal, the first being longer than the last.

The slower the progression of a whirlwind, the greater will be the risk to a vessel scudding in it, of getting before the vortex, or of sailing round it. In

this instance the storm's progress has been computed by Mr. Piddington to have been less than four miles an hour, whilst the vessel was scudding at an average rate of eleven miles.

Log of the Brig* CHARLES HEDDLE, *of Mauritius, Captain* FINK. *Copied by Captain* ROYER, *Master Attendant at that Port, and translated by* HENRY PIDDINGTON. *Nautical Time.

H.	K.	F.	Courses.	Winds.	Lee way.	Var.	Remarks.
							Friday 21st to Saturday 22nd February, 1845.
P.M.							
1	5	4	N E b N	E S E			Horizon very low (*tres rapproché*), thick weather all round. Heavy sea, smart breeze, under the large sails; pumped every two hours.
2	5	4		Variable			
3	5	4		to S E			
4	5	4					
5	6						
6	6						Sea and wind gradually increasing, vessel labouring greatly, weather squally, and threatening all round, the squalls very heavy. At 9.30 P.M. the mainyard went in two in the slings, clued up and furled main-topsail, unbent mainsail, and secured the pieces of the mainyard on the booms. In jib and mizen; scudding under the foresail, fore-topsail, and fore-topmast staysail, to wait for daylight; heavy squalls and sea. Down main-topsail yard, and struck top-gallant-mast. Noon, in close-reef fore-topsail. The gale begins to make itself be felt; scudding under foresail, and fore-topsail. Latitude by Account 16°.42′ S., Longitude Account 57°.45′ E.
7	7						
8	7	4					
9	7						
10	7						
11	6						
12	6						
A.M.							
1	6	4	North	S E			
2	6	4		S S E			
3	6	4					
4	6	4					
5	6						
6	6						
7	7						
8	8						
9	8						
10	8						
11	8						
12	8						
							Saturday 22nd to Sunday 23rd Feb.
P.M.							
1	*13	..	W N W	E S E			Very bad weather; frightful sea; blowing very hard with incessant rain; vessel taking in seas over the quarter while scudding under the foresail and close-reefed fore-topsail. Pumped every hour, vessel labouring greatly from the seas which swept over us. At 2 P.M. perceiving that the head rope of the foresail had given way, sent two hands to cut away the earings, and let
2	13	..	N W	S E			
3	12	..	N N W	S S E			
4	11	..	North	South			
5	11						
6	11						
7	12						
8	12	..	N N E				
9	12						
10	12	..	N E				
11	12						
12	12						

Wind south.

* *About* is marked in the log.

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Log of the Brig CHARLES HEDDLE—*continued.*

H.	K.	F.	Courses.	Winds.	Lee way.	Var.	Remarks.
							Saturday 22nd—*continued.*
A.M.							
1	12						it come on deck, saved the sail.
2	12	..	ENE				The fore-topmast staysail hal-
3	12	..	East				yards having given way hoisted
4	12						the sail by a tackle. Gale at its
5	12						height, scudding right before the
6	12						wind, as it continually veered
7	12	..	ESE				round the compass; pumps at-
8	12						tended to; vessel labouring ex-
9	12						cessively. It being impossible to
10	12	..	SE				clue up the fore-topsail without
11	12	..	SSE				risking severe damage, we re-
12	12	..	South	North			solved to run our chance of what
			SW	NE			might happen.
				ENE			N.B. No position is given on
				East			this day.—H. P.
				ESE	*		
P.M.							Sunday 23rd to Monday 24th Feb.
1	12	..	SW	NE	..	15	Weather always the same with
2	12	..	WSW	ENE			a frightful sea. Shipping from
3	12						time to time very heavy seas;
4	12						one filled the whole deck fore
5	12						and aft with two feet of water;
6	12	..	West.	East			the larboard waist-board carried
7	12						away, much water going down
8	12						the hatchways and cabin scuttle,
9	12	..	WNW	ESE			though all secured by tarpaulins.
10	10	..	NW	SE			4 P.M. fore-topsail blew away,
11	10	..	NNW	SSE			scudding under bare poles, the
12	10						new fore-topmast staysail giving
A.M.							way, saved it; two men at the
1	10						helm, vessel labouring greatly;
2	10						storm always at the same height;
3	11	..	North	South			winds veering round the compass
4	11						from hour to hour, and even in
5	11						half an hour.†
6	11	..	NNE	SSW			Brought all the crew aft into
7	11	..	NE	SW			the cabin to be at hand, closed
8	11	..	ENE	WSW			up the fore-scuttle.
9	11						N.B. No position given on
10	11						this day.—H. P.
11	11	..	East	West			
12	11						Monday 24th to Tuesday 25th Feb.
P.M.							
1	11	..	ESE	WNW	..	13	The gale always at the same
2	12						degree of strength, but the
3	12						squalls a little heavier, pumps

Wind north.

Wind south.

* These last winds and courses are so marked in the log, I presume they mean to designate the changes between Noon and 1 A.M. on the next day, as a memorandum of the gradual veering.—H. P.

† The expression is "*faisant le tour du compas d'heure en heure et meme une demi heure*," of which the literal translation would be, "going round the compass from hour to hour and even in half an hour." What is meant is evidently (by the log) that the wind was going round the compass and *changing* every hour or every half hour.—H. P.

Log of the Brig CHARLES HEDDLE—*continued.*

H.	K.	F.	Courses.	Winds.	Lee way.	Var.	Remarks.	
P.M.							Monday 24th—*continued.*	
4	12	..	SE	NW			always in hand, vessel making	
5	12						water. All the cabins below wet,	
6	11						the provisions in the great cabin	
7	11						also wet, the vessel making water	
8	11	..	SSE	NNW			through every seam in the deck	
9	11	..	South	North			without exception; baled the	Wind north.
10	11						water out of the cabin by buckets.	
11	11						Shipped several seas which	
12	11						went over all.	
A.M.							At two in the morning the	
1	11	..	SSW	NNE			vessel broached-to, the water	
2	11	..	SW	NE			two feet deep on the deck: we re-	
3	11	..	WSW	ENE			mained in this dangerous posi-	
4	11						tion for about ten minutes, when	
5	11						she righted. We broached-to	
6	11	..	West	East			again several times from the speed	
7	11	..	WNW	ESE			of the vessel; * cleared the scup-	
8	11						pers. At 10, shipped a sea in the	
9	11	..	NW	SE			fore rigging which carried away	
10	11						jib and flying jib-boom. Cut	
11	11	..	NNW	SSE			away the wreck to clear the	
12	11						bowsprit.	
							Latitude by a doubtful Observation..... 16°.18′ S.,	
							Longitude Chronometer..... 53°. 2′.30″	
							Tuesday 25th to Wednesday 26th February.	
P.M.								
1	11	..	North	South	..	20	The gale always at the same	Wind south.
2	11	..	NNE	SSW			strength without the least in-	
3	11						termission, heavy sea and rain.	
4	10	..	NE	SW			The tiller ropes gave way,	
5	10	..	ENE	WSW			changed; then the boats also of	
6	10	..	East	West			the tiller having given way,	
7	10	..	ESE	WNW			drove in preventer ones.	
8	10						P. S. Every hour. The trus-	
9	10	..	SE	NW			ses of the foreyard gave way,	
10	10	..	SSE	NNW			replaced them; scudding under	
11	10	..	South	North			bare poles. The sea frightful,	
12	10	..	SSW	NNE			vessel making much water	
A.M.							through the deck.	
1	10	..	SW	NE			Crew worn out with fatigue.	
2	11	..	WSW	ENE			The sun appeared indistinctly at	
3	10	..	West	East			noon whereby we obtained an	
4	10	..	WNW	ESE			indifferent latitude and longitude.	
5	10	..	NW	SE			Latitude by indifferent Observation, 18°.02′ S.,	
6	10	..	NNW	SSE				
7	10	..	North	South			Longitude ditto	
8	10	..	NNE	SSW			ditto,..... 51°.2′.30″ E.	
9	10	..	NE	SW				
10	10	..	ENE	WSW				
11	10	..	East	West				
12	10	..	ESE	WNW				

* The words are "*par la vitesse du batiment.*" No doubt the difficulty of steering her is here implied.—H. P.

CHAP. IX.

Log of the Brig CHARLES HEDDLE—*concluded.*

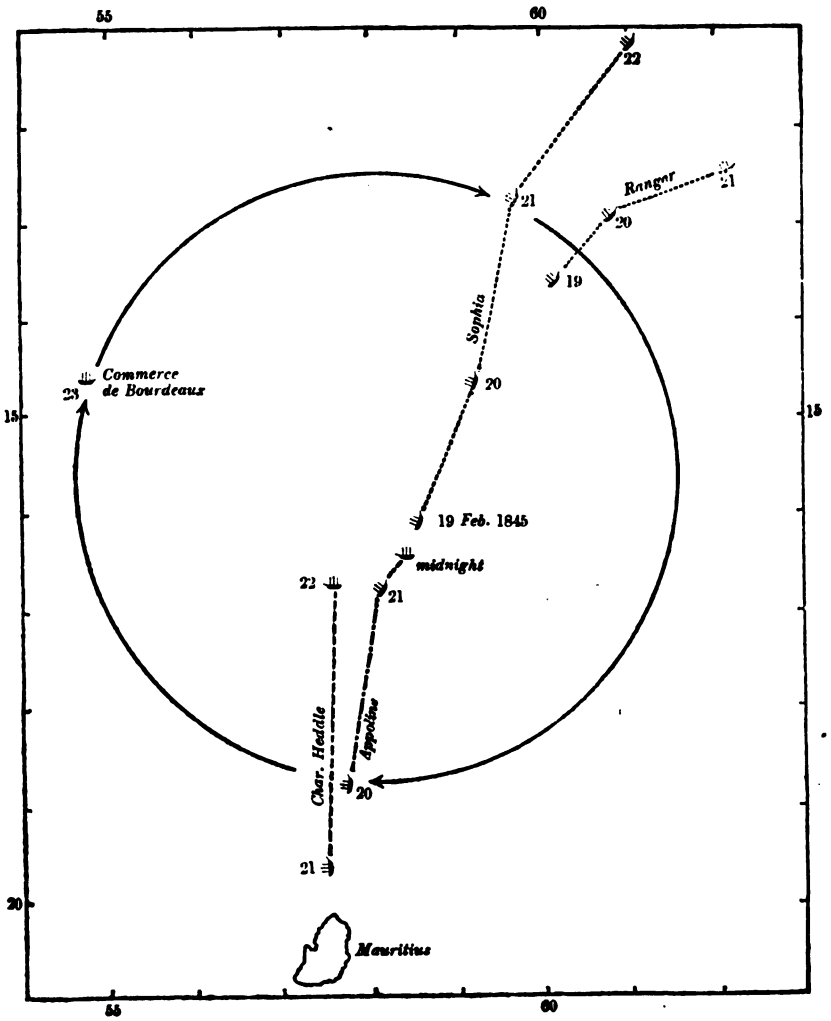
H.	K.	F.	Courses.	Winds.	Lee way.	Var.	Remarks.
							Wednesday 26th to Thursday 27th February.
P.M.							
1	10	..	SE	NW			The horizon always obscure though sometimes clearing a little, but the squalls and sea always heavy; pumped every hour.
2	10	..	SSE	NNW			
3	9						
4	9						
Wind north. 5	9	..	South	North			Two men at the helm. Always
6	9	..	SSW	NNE			under bare poles. At 10 P.M.
7	10	..	WSW	ENE			clearing up a little, and we saw
8	10	..	West	East			some stars, but the sea and wind
9	10	..	NW	SE			always heavy.
10	10	..	NNW	SSE			Bent fore-topmast staysail, and
Wind south. 11	10	..	North	South			fore and aft mainsail with two
12	10	..	NNE	SSW			reefs in it. Bent another fore-topmast staysail on the forestay
A.M.							
1	10	..	NE	SW			to balance the vessel's sails.*
2	10	..	ENE	WSW			Scudding always according to
8	10	..	East	West			the veering of the wind.
4	10	..	ESE	WNW			Seeing that we had sustained
5	10	..	SE	NW			much damage, and that we were
6	10	..	SSE	NNW			nearer to the Mauritius than to
Wind north. 7	10	..	South	North			any other place, the Captain
8	10	..	SSW	NNE			resolved to return there, not
9	10	..	SW	NE			considering the vessel in a state
10	10	..	WSW	ENE			to continue her voyage.
11	10	..	West	East			Latitude Observation, 20°.12′ S.
12	10						Longitude Chronometer ..... 52°.24′ E.
							Thursday 27th to Friday 28th February.
P.M.							
1	7	..	SE	ENE			The weather becoming fine,
2	7	..	SSE	Variable			bent the foresail and spare fore-topsail, took the main-topsail
3	7	..	ESE	to NE.			yard for a mainyard, and let
4	7						the reefs out of the fore and aft
5	7						mainsail.
6	6	4					Cloudy still, and lightning in
7	6	4					all quarters.
8	6	4					Fine, and sea smooth with a
9	6						pleasant breeze.
10	6						Latitude Observation 20°.19′ S.
11	6						Longitude Chronometer, ... 54°.22′.28″
12	6						

* *i.e.* When sail should be made, having lost the jib-boom.

Judging from the abridged log-books of three ships, namely, the John Adams, Sophia, and Ranger, which had preceded the Charles Heddle on the same course from Mauritius, bound to India, this hurricane appears

to have arisen between the place of the Charles Heddle and the other three ships.

To trace out the spot where storms originate being a subject of much interest, I shall here reprint Mr. Piddington's abridged extracts from the log-books of these three vessels. Had this tempest come from the eastward, the Adams, Sophia, and Ranger would



CHAP. IX.

have encountered it, and have had a storm blowing southerly. But the only hard squalls these ships experienced were from the northward. It seems therefore probable, that the tempest in which the Charles Heddle became involved, was formed at the place where, and time when she encountered it.

"*Abridged Log of the Ship* JOHN ADAM, *Captain* MANSFIELD, *from Mauritius to Calcutta, reduced to Civil Time.*

John Adam.

"The John Adam left the Mauritius in company with the Sophia, and at noon, 20th February, 1845, was in Lat. 14°.36′ S., Long. 59°.38′ E., with a fine S.E.. trade; P.M. the same; midnight, calm.

"*20th to 21st February.*—A.M. Wind E.S.E., E., and at noon, N.N.E. A.M. Squally; no observation. Lat. Acct. about 12°.30′, Long. 59°.30′ E. P.M. Increasing wind northerly; vessel standing to the eastward, with a high confused sea. 9 P.M. Wind N.W., course N.E. ½ E. 4 P.M. Bar. 29·50. Made preparation for bad weather. 10 P.M. to midnight, hard gales, and constant rain. Wind N.W. from 9 P.M.

"*22nd February.*—A.M. Moderating; N.W. wind, and vessel making sail accordingly. Noon, no observation, Lat. by Acct. about 11°.30′, Long. Acct. 61°.10′ E., Bar. 29·50, Ther. 83·10. Squally and unsettled, wind N.W. P.M. to midnight, wind N. N.W., the same weather.

"*23rd February.*—To noon, wind N. N.W., and weather becoming settled. Lat. 16°.26′ S., Long. 62°.44′ E. Bar. 29·75, Ther. 80·40."

"*Abridged Log of the Ship* SOPHIA, *Captain* SAXON, *from Mauritius to Calcutta, reduced to Civil Time.*

Sophia.

"The Sophia left Mauritius on the 16th February.

"*19th February.*—At noon, in Lat. 16°.4′ S., Long. 53°.44′ E. Bar. 29·65, Ther. 84°, and fine weather, with three to five-knot breezes from E. to E.S.E. P.M. Decreasing breeze, and cloudy to midnight.

"*20th February.*—A.M. Winds variable, S.E. to noon, with squalls and heavy rain. 8 A.M. Dark, squally, threatening appearance. Noon, Lat. Obs. 14°.40′ S., Long. 59°.13′ E. Bar. 29·88,

Ther. 62°. P.M. Wind easterly, variable, and N.E. Towards 9 P.M. northerly, and weather very threatening, making preparations for bad weather. At 10.30 P.M. sudden shift to the E.

"21*st February*.—A.M. Winds to noon S., S.E., E., and N.E. Noon, heavy squalls and thick rain. Barometer falling, and all preparations for bad weather. Lat. Acct. 12°.51′ S., Long. 59°.38′. Bar. 29·60, Ther. 81°. 1 P.M. Tremendous heavy squalls, wind N.W., every appearance of a hurricane. 7 P.M. Bar. 29·30. At 10 P.M. blowing a fresh gale, ship standing to the N.E., seven knots per hour, with wind at N.W. to midnight.

"22*nd February*.—Midnight, *more moderate, and barometer rising*. Daylight, out all reefs, wind N. Lat. noon by Acct. 11°.21′ S., Long. 61°.60′. Bar. 29·79, Ther. 81°. Weather squally. P.M. Weather still thick, but by midnight clear."

"*Abridged Extract from the Log of the Ship* RANGER, *Captain* STEPNEY, *from the Mauritius, bound to Madras, reduced to Civil Time.*

"19*th February*, 1845.—At noon, the Ranger was in Lat. 13°.34′ S., Long. 60°.20′; light winds N., calms, with a heavy appearance to the N.E. and hazy horizon. Midnight, sea smooth, cloudy and squally. Ranger.

"20*th February*.—Noon, Lat. 12°.56′ S., Long. 60°.53′ E. Light variable S. and S.E. airs; hazy sultry weather, and *uncommon black squally appearance to the northward*. P.M. Wind veered to the northward, remaining variable and squally to midnight, and between N. and N. by E., with calms and squalls, and thick dark weather.

"21*st February*.—To noon, increasing breeze N. by E. Lat. Obs. 12°.31′ S., Long. 62°.00′ E.—Note. For the last two days a current to the west of about one mile per hour.—P.M. Fresh gale increasing to midnight; from N. at noon. At 5 P.M. N. by E. to N. by W., and at 12, N. again. Midnight, increasing gale and squalls.

"22*nd February*.—A.M. to noon, fresh gale and hard squalls, the wind *wet and sultry*. At noon, Lat. 12°.0′ S., Long. 64°.3′ E., Var. 5° W., course by Obs. is E. by N. ¼ N. 127′. P.M. to midnight, fair.

"23*rd February*.—Noon, light and fine weather. Lat. 11°.26′ S., Long. 66°.18′ E."

The Appoline sailed from Mauritius on the 19th of

CHAP. IX. February, three days later than the Adams and Sophia. Her place on the 21st is marked in the diagram, and that afternoon she was preparing for bad weather. By four o'clock next morning, this vessel was hove-to; by noon she was in a hurricane blowing east by south. The abridged extract from the log-book is as follows:

"*Abridged Log of the Ship* APPOLINE, *Captain* THOMAS, *from the Mauritius, bound to Calcutta, Civil Time.*

Appoline. "The Appoline left the Mauritius on the 19th February, 1845, with light N.E. winds to midnight of that day.

"*20th February.*—Winds E.N.E., E., and variable. At 11 A.M. cloudy, suspicious weather. At noon, heavy squall and rain. Lat. by Acct. 18°.50′; Round Island, having borne at 6 A.M. S.E. by S..... since when the ship had made 23′ N.N.E., hence the Long. about 57°.50′ E. P.M. to midnight, squally, moderating and freshening again, wind from N.E. by E. and E.; ship standing from noon to midnight to the N.E. by N. and N.N.E.

"*21st February.*—A.M. Wind E.S.E., fresh breeze and cloudy; vessel standing to the N.E. by N. 68′ to Lat. 16°.52′ S., Long. 58°.10′ E. by account. P.M. Barometer falling, making preparation for bad weather. At midnight, brisk gales and cloudy; ship standing to the N.E., wind S.E. by E.

See fig. page 213.

"*22nd February.*—A.M. Wind S.E. by E.; by noon, blowing a complete hurricane in the squalls. 4 A.M. Hove-to. P.M. Wind marked E. by S., weather the same, and a cross sea. At 8, barometer still falling.

"*23rd February.*—The same; heavy gale and rain; blowing a complete hurricane during the squalls. At 8 A.M. Bar. 28·5; wind marked E.S.E. to noon; and P.M. S.E. by E. to midnight, the weather the same.

"*24th February.*—P.M. Wind marked E. At 8 A.M. blowing a complete hurricane, with much rain. Bar. 28·5. Ship under bare poles, head to the northward. P.M. The same, wind E. by N.; and at 3, N.E. by E. At 2 P.M. wore ship to the S.E., the weather the same.

"*25th February.*—At 4 A.M. more moderate. Barometer rose 0·2. At 8 A.M. made a little sail. Noon, Lat. Acct. 16°.53′, Long. 55°.31′ E., and by midnight, the weather was moderate."

Mr. Thom, author of a work entitled "An Enquiry into the Nature and Course of Hurricanes in the Indian Ocean South of the Equator," has added much valuable information on this part of the subject. Being at Port Louis, Mauritius, when the vessels damaged in the Rodriguez hurricane put in there to refit, Mr. Thom drew diagrams of that hurricane's course and rotatory motion, in order to ascertain the truth of the theory of storms, as well as to demonstrate the real character of this hurricane, to some of the parties who had been in it, whilst the event was still fresh in their memories. In his published work he has given twelve of these diagrams, which show the relative positions of the ships, day by day. His diagrams give a deep interest to his demonstrations, and render his narrative a very instructive lesson.

The earliest indication of this whirlwind, he refers to the 23rd and 24th of March, 1843, in about Lat. 7° S., and Long. 79° E. He has obtained and published accounts of what befel fourteen ships in that gale, all sailing westward. I have laid down the progress of the Rodriguez hurricane on the same chart with the storm of 1842, in the northern hemisphere, traced by Mr. Piddington, in order that these two storms on opposite sides of the Equator may be the more easily compared. By referring to the chart, page 15, the Katherine Stewart Forbes will be found marked to the eastward of this hurricane's course; and as that vessel did not there experience bad weather, it may be inferred, that the hurricane originated somewhere to the westward of the place of that ship on the 24th of March. Nearly all the fourteen ships in their turn became involved in the vortex of this storm. I

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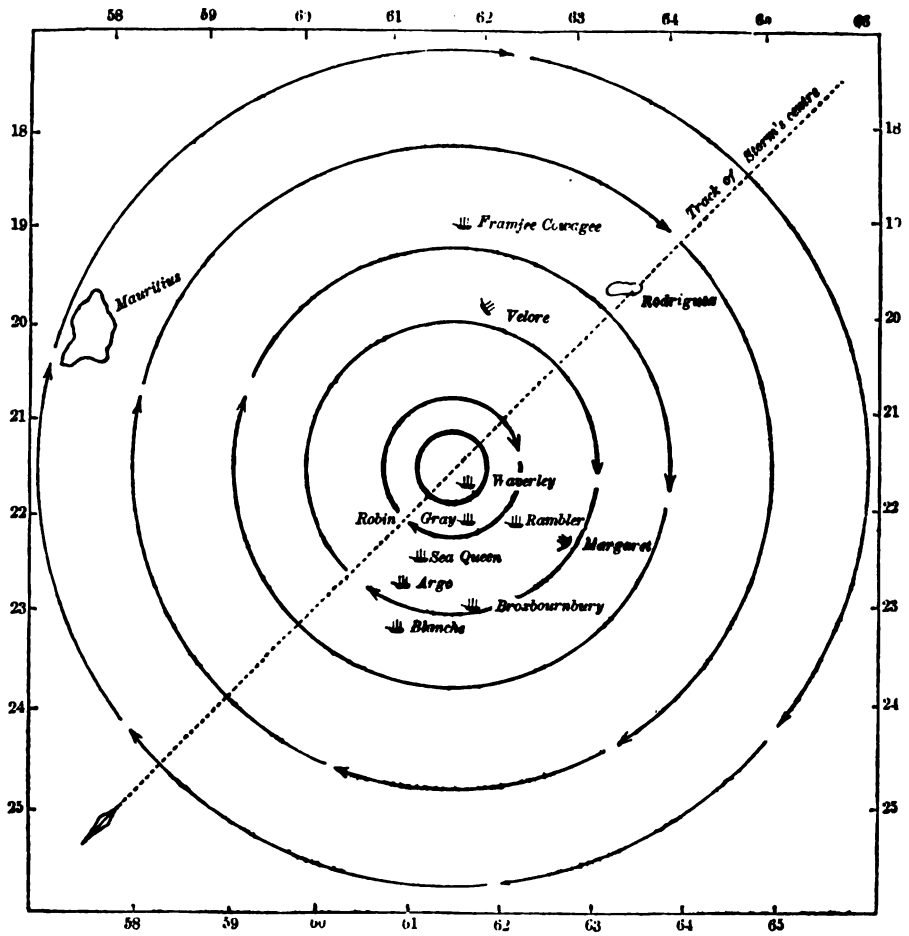
have laid down upon the chart the tracks of six of them, in order to show the manner in which they sailed into danger. Between the 24th of March and the 4th of April, the rate of the hurricane's progression to the westward was faster than that of the ships, and therefore some were overtaken by it. But after the 4th of April, when it appeared to have begun to recurve, its diurnal progress greatly diminished, so that some of the same ships which the storm had passed



over before, by making sail overtook it again, and became a second time involved in its vortex.

The opposite diagram shows the place of eight ships with relation to the storm's centre on the 6th of April, when the storm was moving with a south-west progression, and these ships were running in front of the advancing vortex.

It will be seen on the chart how the Katherine Stewart Forbes, whilst steering for the Cape of Good Hope, sailed parallel to the storm, and just upon the edge of it, for twelve days. As might well be expected, her log-book records a "heavy swell; occasionally severe squalls; unsteady trades; rain, and strong winds." On the 31st March, it appears that she had her main-royal and fore-topmast-staysail set, but split them both. On 1st April, she was carrying studding-sails, with what is described in the log, as strong variable trades .From that day to April 6th, this ship was far enough from the edge of the storm to have fine weather: but by that time the storm, having begun to move more southerly, was approaching the track of the ship. On the 6th, the Forbes entered that confused cross sea, which a whirlwind storm always raises. She is described as rolling awfully, and studding-sails, royals, and top-gallant-sails were taken in.

Chart, page 15.

This affords a striking example of the dangerous position ships are sometimes in, by meeting storms where they recurve, about the twenty-fifth or thirtieth degree of latitude.

Storms when recurving.

The other five ships, whose courses are laid down upon the same chart, all sailed into the hurricane on the opposite side; and that being the side next the Equator, they had at first westerly winds. Had these ships

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been placed upon the *port-tack* (being in the southern hemisphere), they would have sailed from the centre of the storm; but their commanders at the time were not aware of the nature of progressive revolving hurricanes.

I shall here reprint the extracts from the log-books of those six ships, from the appendix of Mr. Thom's volume.

"*Extracts from the Log of the* KATHERINE STEWART FORBES, *from Singapore to London, 1843, in Nautical Time.*

Katherine Stewart Forbes,

"23*rd March*, 1843.—Wind S.W. to E. by S., *squally and heavy rain*. Lat. 11°.25′, Long. 98°.46′ E.

"25*th*.—Wind E.S.E. Lat. 11°.59′ S., Long. 95°.52′ E.

"26*th*.—Wind E.S.E. Lat. 13°.34′ S., Long. 92°.31′ E.

"27*th*.—Wind S.E. Lat. 14°.48′ S., Long. 89°.20′ E.

"28*th*.—Wind S.E. to E., *heavy swell, running west, squally* and showery; topgallant-sails set. Lat. 15°.44′, Long. 86°.25′ E.

"29*th*.—Wind E. by N., '*dirty weather, heavy rain, and severe squalls*.' 'Shipping seas all over.' Carried away some sails. Lat. 16°.20′, Long. 83°.18′.

"30*th*.—Wind E. by N., more moderate, but heavy rain. Set studding-sails. Lat. 17°.20′, Long. 81° E.

sailing parallel to the storm.

"31*st*.—Wind E., '*unsteady trades, strong winds, heavy sea, constant rain*, split main-royal and foretop-staysail.' Lat. 17°.45′, Long. 78°.39′.

"1*st April*.—Wind E., 'strong variable trades,' rainy, latter part more settled; carrying studding-sails. Lat. 18°.28′, Long. 75°.59′.

"2*nd*.—Wind E., light wind, variable, calm, at 6 P.M. 'A beautiful starlit night,' followed by a 'delightful morning, and every appearance of a fine day.' Lat. 18°.51′, Long. 73°.58′.

"3*rd*.—Wind E. by N., fine. Lat. 19°.13′ S., Long. 72°.5′ E.

"4*th*.—Wind E.N.E., steady trades, fine weather. The 'night beautifully fine and starlit.' Lat. 20°.21′, Long. 70°.8′ E.

"5*th*.—Wind E.N.E., fine weather, beautiful night; carrying studding-sails. Lat. 21°.32′, Long. 68°.20′.

"6*th*.—Wind E.N.E., course W.S.W., first part fine, latter part squally, '*heavy rain and a confused sea*,' ship rolling heavily

and shipping water over all. Midnight, *every appearance of a breeze*, heavy swell arising from S.E., ship rolling awfully; in all studding-sails, royals, and topgallant-sails. Lat. 22°.30′, Long. 66°.12′.

H.	K.	Courses.	Winds.	Remarks.	
				April 7.	
1	6	WSW	ENE	A heavy cross sea and blowing heavy, ship	
2	6			rolling and straining a good deal, besides ship-	
3	6			ping seas over all fore and aft, a quantity of	
4	6			water went down the store-room scuttle into	
5	6			the cabin. Ship under sail according to the	
6	6			wind. At 8 A.M. ship rolling awfully, and	Ship and storm meeting.
7	6			taking seas into the cabin through the doors.	
8	6			All the watch trying to keep the water from	
9	6			going down at aft, by baling, but of no avail;	
10	6			ship making water with us fast, starboard	
11	6			pumps of no use. At 4 A.M. both the topsails	
12	6	West	East	went down out of the bolt-ropes. At daylight,	
				a tremendous gale or *hurricane*, with a confused	
1	6			cross sea running at E. and S.E.; stowed every	
2	6			sail except the foresail, and scudded under it.	
3	6			At 10, thick weather and rain; sounded the	
4	6			well at noon, and found ship making a great	
5	6			deal of water, all hands employed in baling	
6	6			water out of the cuddy, and the rest keeping	
7	6			the pumps agoing. Sun obscured.	
8	6			Lat. 22°.58′, Long. 63°.40′ E.	
9	6				
10	6				
11	6				
12	6				
				April 8.	
1	3	West	East	A severe hurricane and a tremendous sea	
2	4			running, ship completely burying herself in the	Running deep into the storm.
3	5			sea; found all her upperworks working. Exa-	
4	5			mined and found all the stancheons gone short	
5	5			off by the covering-board fore and aft; ship	
6	5			labouring awfully; could not heave the ship	
7	5			to for the sea for fear of clearing ship decks.	
8	5			At midnight, ditto weather: a sea struck us	
9	6			on the poop and carried away the gig and da-	
10	6			vits, and bent the cutter's iron davit right up;	
11	6			smashed the poop-skylight and donkey-boom,	
12	6			and sent everything adrift on the poop. At 8	
				A.M. held a consultation among the officers	
1	6			and men of the vessel about lightening her	
2	6			abaft, and were all of opinion that no time	
3	6			should be lost in doing so for the preservation	
4	6			of the ship and our lives.	
5	6			Commenced throwing articles overboard.	
6	6			Lat. 23°.30′, Long. 60°.50′ E., per account.	
7	7				
8	7	....	SE		
9	7	Hove-to			Hove-to.
10	1				
11	1				
12	1				

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Extracts from the Log of the KATHERINE STEWART FORBES—*continued.*

"NOTE FROM MR. BUTTERWORTH, SECOND MATE.

Wind veering.

"In the course of these twenty-four hours the wind gradually veered round S. and S.S.W. At noon it was S.W., when the ship was hove-to on the larboard tack, and gradually fell off to N.E. on the same tack all the time. The ship was on the larboard tack when the guns were thrown overboard.

H.	K.	Courses.	Winds.	Remarks.
				April 9.
Lightening the ship. 1	..	N W	S W	Blowing furiously, and an outrageous sea
2				running; stowed foresail, and hove-to under
3				main-trysail and foretopmast-trysail. Still
5				heaving cargo overboard, and at the pumps.
4				A 2 P.M. a sea struck us and carried away
6				all the stancheons and bulwarks fore and aft,
7				taking with it eighteen water-casks of different
8				sizes, starboard swinging-boom, pigsty, three
9				flour-casks, gun-shot; two guns being adrift,
10				were obliged to throw them overboard; car-
11				ried away all our bowsprit, bobstay, &c. People
12	..	N E	N W	clearing the wreck and at the pumps. Got
				spars and ridge-ropes fore and aft the side of
1				the ship for safety. Seas going clear over us
2				and quantities of water going below. Blowing
3				a tremendous hurricane of wind. Got the bow-
4				sprit secured again,* all the ship's upper-works
5				completely adrift, headrails, bumpkins, and in
6				fact all her topsides.
7				At noon, ditto weather; all hands at the
8	..	....	West.	pumps, or clearing away the wreck. Found
Ship more lively. 9				the ship much more lively and making much
10				less water; starboard pump useless.
11				Lat. 23°.20′, Long. 61°.30′.
12				
				April 10.
Moderating. 1	..	North.		At 1 P.M. weather moderating. Set foresail
2				and mizen to steady her. Ship still rolling
3				and shipping quantities of water fore and aft;
4	3	....	N N W	less wind. Split the mainsail and main-top-
5	4			gallant-sail during the gale. People at pump
6	3			and securing things on deck. People living in
7	3			the after-cabin during the gale. Three pigs
8	3			drowned, and three dozen fowls, &c. &c.
9	3			Midnight, much finer, ship not making so
10	3			much water; only pumped ship every four
11	3			hours. Everybody's clothes wet fore and aft.
12	3			At daylight, bent the best topsails and set them,
				also the jib and fore-topgallant-sail; repaired
1	3			mainsail and set it; sent main-topgallant-sail
2	3			down to repair it.

* The vessel was kept before the wind for four hours while securing the bowsprit.

Extracts from the Log of the KATHERINE STEWART FORBES—*continued.* CHAP. IX.

H.	K.	Courses.	Wind.	Remarks.
				April 10—*continued.*
3	3			Noon, weather clearing up, ship not making much water; sea going down; six seamen laid up sick through the weather. During the bad weather gave the ship's company grog four times a-day.
4	3			
5	3			
6	3			
7	3			
8	3			Lat. 22°.53′, Long. 60°.4′.
9	3			
10	3			
11	3			
12	3			

"11*th April.*—1 P.M. Wind N. by W., course W. by N. 3 miles; 12, wind N.N.W., course W., 3 miles. 1 A.M. Wind N.W., course W., 3 miles; 12, wind N.W., course W.S.W., 3 miles; fine weather but variable; *heavy swell* continues; wind light. Lat. 23°.21′, Long. 59°.38′ E.

"12*th.*—2 P.M. Wind N.W., course W.S.W.; 4 A.M., wind W., course S.S.W., moderate weather, wind light and changeable; a swell. Lat. 24°, Long. 58°.14′ E. Bore up for Mauritius.

"13*th.*—Wind N.W., bore up for the Isle of France."

"*Extracts from the Log of the Barque* VELORE, *from Calcutta to Mauritius. A light ship, Coolies on board, in Nautical Time.*

"26*th March*, 1843.—Wind S. S.W. Lat. 9°.47′, Long. 83°.45′. Ther. 84°. All sail. Bar. 29·60. Velore. Chart, page 15.

"27*th.*—Wind S.E. Lat. 11°.5′, Long. 81°.41′. Bar. 29·50, Ther. 84°. Fresh gale.

"28*th.*—Wind S.E. Lat. 13°.52′, Long. 79°.36. Bar. 29·60, Ther. 84°. Single-reefed topsails.

"29*th.*—Wind E.S.E. Lat. 15°.20′, Long. 76°.58′. Bar. 29·55, Ther. 84°. Two reefs in the topsails.

"30*th.*—Wind S.S.E. Lat. 16°.7′, Long. 75°.10′. Bar. 29·45, Ther. 84°. Close-reefed topsails.

"31*st.*—Wind S.E. Lat. 16°.15′, Long. 71°.12′. Bar. 29·46, Ther. 84°. Close-reefed topsails. Storm overtaking ship.

"1*st April.*—Wind S.S.E. to S.E., course S.W., scudding; heavy gales, dirty weather, rainy. 2 A.M. Lightning, thunder,

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Extracts from the Log of the Barque VELORE—*continued.*

and rain. Three reefs in the topsails. Run 164 miles in twenty-four hours. Lat. 18°.48′, Long. 69°.33′.

"2*nd.*—Wind E.S.E. and S.E., squally, wild, unsettled, at one time carrying top-gallant-sails, and the next close-reefed topsails. Course 188 miles to S.W. Lat. 19° S., Long. 65°.47′.

H.	K.	F.	Courses.	Wind.	Lee way.	Remarks.
						April 3.
1	8	..	W by N	E by S	..	P.M. Strong trades and squally, with
2						rain; two-handed the mainsail, in
3	8	4				mizen and maintop-gallant-sail. 2.30,
4	7					in second and third reefs main topsail,
5	7					and second and third reefs from topsail,
6	7					and up foresail. 4, more moderate, set
7	7					foresail. 6, strong gales and squally,
8	7					with rain; well, 9½ inches.
9	7					Midnight, strong gales and squally,
10	7					ship labouring heavily and shipping a
11	7					great quantity of water on deck, the
12	7					sea continually breaking on board.
						A.M. Strong gales and squally, with
1	7	4	W by N			rain at times. 4, strong gales; pumped
2	7	4				ship at ten inches with a heavy sea,
3	8	4				ship labouring heavily and shipping
4	8	4				great quantities of water, the sea con-
5	7	4				tinually breaking on board, and strong
6	7	4				gales and squally, with rain. Noon,
7	7	..	W by N			increasing gale with rain; close-
8	7		½ N			reefed the topsails, and reefed the fore-
9	7					sail, ship shipping a great quantity of
10	7	4				water, a heavy cross sea. Sun obscure.
11	7	4				Lat. 20°. 47′, Long. 63°. 10′ Account.
12	7	4	W ½ N	E		(Lat. 20°.)
						April 4.
1	7	..	West	E by S	..	P.M. Strong gales and squally, with
2	7					heavy rain. 2.30, hauled main-top-
3	6					sail and foresail. 4, increasing gales
4	6	..	W N W			and squally, with heavy rain. 6, hard
5	6					gales with heavy squalls; wore ship to
6	6					the northward, hauled the fore-topsail,
7	1	..	up E	....	7	and brought the ship to under larboard
8	1	..	off N E by E	....	7	reef main trysail. At 8, wore ship to the westward; hard gales, with heavy
9	1	..	up S W	S S E	7	squalls and rain. 9.30, starboard lower
10	1	..	off W by S	....	7	boom washed away.
11	1		....	....	7	Midnight, hard gales with heavy
12	1	..	....	S E	7	squalls and constant heavy rain; ship labouring heavily, and shipping great quantities of water.
1	1	..	up S W	S S E	7	A.M. Increasing gales with heavy
2	1	..	off W by S	....	7	squalls and heavy rain. 4, gale in-
3	1	..	....	....	7	creasing and a heavy sea. 6, gale in-
4	1	..	....	South	7	creased to a perfect hurricane, blowing
5	1	..	....	....	7	the sails adrift from the yards; a heavy
6	1	..	up W	....	7	sea running, labouring heavily and

Sails blowing away.

Extracts from the Log of the Barque VELORE—*continued.*

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H.	K.	F.	Courses.	Winds.	Lee way.	Remarks.
						April 4—*continued.*
7	1	..	off W N W	....	7	shipping much water. 8, wore ship to
8	1	..	....	S S W	7	the southward. Noon, hard gales with
9	1	..	up S S E	S W	7	heavy squalls and a heavy cross sea;
10	1	..	off S E	....	7	ship labouring heavily, and shipping
11	1	..	....	....	7	great quantities of water. Sun ob-
12	1	..	up S S W off S	W S W	7	scured. Lat. 19°. 27′, Long. 62°. 36′ E.
						April 5th.
1	1	..	up SW by S	W by N	7	P.M. Strong gales, with a heavy cross
2	1	..	off S by W	....	7	sea, ship labouring heavily, and ship-
3	1	..	....	....	7	ping much water; sent down top-gal-
4	1	..	....	....	7	lant-yard.
5	1	..	up S W	W N W	7	At 4, strong gales, with heavy squalls.
6	1	..	off S S W	....	7	8, hard gales, with a tremendous
7	1	..	up SWb.W	N W by W	7	heavy sea.
8	1	..	off SW by S	....	7	Midnight, strong gales, with light
9	1	..	up W S W	N W	7	rain at times. A.M. Strong gales and
10	1	..	off S W	....	7	squally, with small rain at times. 4,
11	1	..	....	....	7	more moderate weather. Daylight, set
12	1	..	....	....	7	fore-topmast-staysail, fore trysail, and
1	1	..	up W	N N W	7	reefed mizen. At 6. 45, saw the island
2	1	..	off W S W	....	7	of Rodriguez bearing N.E. by E., dis-
3	1	..	....	....	7	tance 4 or 5 leagues.
4	1	..	....	....	7	Noon, more moderate, with a heavy
5	1	..	up W by S	N W by N	7	N.W. sea; set close-reefed fore and
6	1	..	off SWb.W	....	7	main topsail.
7	1	..	....	....	6½	Lat. 19°. 57′, Long. 62°. 50′ E.
8	1	..	....	....	6	
9	1	..	up W	N N W	5	
10	1	4	off W by S	....	5	
11	1	..	....	....	5	
12	1	4	....	....	5	
						April 6.
1	2	4	W by N	North	2	P.M. Strong gales, with squally ap-
2	2	4	....	....	2	pearance, ship pitching very heavily.
3	3	..	....	....	2	4, fresh gales and squally, sent in
4	4	..	W S W	N W	2	flying-jib and boom.
5	4	..	....	....	2	6, squally, appearance of bad wea-
6	4	..	N by S	N W by N	2	ther, hauled main-topsail.
7	2	..	up W by N	N by W	2¼	8, fresh gales and squally, with small
8	2	..	off W ½ N	....	2¼	rain at times.
9	2	4	up W N W	North	2¾	Midnight, moderate gales and clear
10	2	4	off W	....	3	weather; moderate gale and clear.
11	2	4	....	....	3	
12	2	4	....	....	3	
1	2	..	up W N W	North	3	4 A.M. Decreasing gales and cloudy,
2	1	4	off W ½ S	....	3	with rain at times. Daylight, set main-
3	1	4	....	....	3	topsail and foresail, out close-reefed,
4	1	4	....	....	3	set the jib. A sail on lee-boom stand-
5	1	4	W by N	N by W	4	ing to the southward. Out third reef
6	1	4	....	....	4	topsails and reefs of the courses and
7	3	4	....	....	2	mizen, set gaft-topsail.
8	3	4	....	....	2	

Ship drifting round storm's vortex.

Velore off Rodriguez

Ship left behind by storm.

CHAP. IX.

Extracts from the Log of the Barque VELORE—*concluded.*

H.	K.	F.	Courses.	Winds.	Lee way.	Remarks.
						April 6—*continued.*
9	3	4	W N W	North	2	At 11, out second reef main topsail.
10	4	4	N W by N	N by E	2	Noon, fresh breeze and cloudy.
11	5	..	W by N ½ N	N by W	1½	Lat. 20°. 8′ S., Long. 62°. 10′ E.
12	5	4	....	....	1	
						April 7.
1	4	..	W ½ N	N W		P.M. Strong breeze and squally, with
2	4					rain. Out second reef of the topsails,
3	4	..	West	N N W		hoisted top-gallant-yards.
4	4					2. 30, set main-top-gallant-sail.
5	4	4				4, moderate breeze and cloudy.
6	4	4				At 7, in gaft-topsail and main-top-
3	4	4				gallant-sail.
8	4	4				At 8, strong breeze and cloudy, in
9	4	4				second reef of the topsail.
10	4					Midnight, strong breeze and squally
11	4					at times.
12	4					A.M. Strong breeze and squally.
						At 3. 30, set mainsail.
1	4	4	W by S	N W by N		At 4, moderate breeze and cloudy,
2	4	4				with rain.
3	4	..	W S W	N W		At 5, wore ship to the westward.
4	4	4				At 8, strong breeze, with a heavy
5	4	4	S by W	W by S		S.W. swell; out second reef fore-top-
6	4	..	W by N ½ N	S W ½ S		sail; set main-top-gallant-sail.
7	5					At 10, in second reef fore-topsail, and
8	5					furled main-top-gallant-sail.
9	5	4	W N W	S W		Noon, fresh breeze, with a heavy
10	5	4				S.W. swell.
11	4	4				Lat. 20°. 25′ S., Long. 60°. 30′ E.
12	4					
						April 8.
1	5	..	W N W	S W	1	P.M. Strong breeze, with passing
2	5	..	....	....	1	squalls. Watch as most useful.
3	5	4	W by W ½ N	S W ½ W	1	At 3, set main-top-gallant-sail.
4	5	4	....	....	1	At 4, fresh breeze and cloudy, with
5	6	..	W N W	S W	1	a very heavy S.S.W. swell.
6	6	..	....	....	1	At 6, increasing breeze and cloudy.
7	6	..	....	....	1	At 8, steady breeze, and fine clear
8	6	..	....	....	1	weather.
9	5	4	S W by W	S W by W	1	At 9, set fore-top-gallant-sail.
10	5	4	....	....	1	Midnight, fresh breeze and fine clear
11	6	..	....	....	1	weather, with a very heavy S. S. W.
12	6	..	....	....	1	swell.
						A.M. Fresh breeze and cloudy.
1	6	..	N W by W	S W by W	1	At 4, steady breeze and cloudy, with
2	6	..	½ W	....	1	a heavy sea from the S.S.W.
3	6	..	....	....	1	Daylight, out second reefs of the
4	5	..	....	....	1	topsails.
5	5	..	W by N	S W ½ W	½	At 8, decreasing breeze and fine.
6	5	..	½ N	....	1½	Noon, steady breeze and fine weather;
7	4	..	W N W	S W	1½	out first reef fore-topsail, tacked ship
8	4	..	....	....	1½	to the S.E., a strong northerly current.
9	4	4	....	....	1½	Lat. 19°. 28′, Long. 58°.
10	5	..	W by N ½ N	S W ½ S	1½	
11	5	..	....	....	1½	
12	4	4	W by W	S W S	1½	

See diagram, page 218.

"*9th.*—In Lat. 20°.3′, Long. 58°.58′. Wind S.W., fine, a heavy southerly swell.

"*10th.*—Lat. 20°.43′. Wind W. to N.N.W. At 3 P.M., spoke the Broxbournbury."

Extracts from the Log of the Ship SEA QUEEN. (*Nautical Time*).

"*25th March,* 1843.—Wind S. by W., a long swell from south. Lat. 7°.58′ S., Long. 82° E. Sea Queen. Chart, page 15.

"*26th.*—Wind S.W., S., and S.E., squally and gloomy appearance, raining, 'supposed to be the commencement of the trade.' Lat. 8°.49′ S., Long. 81° E. A heavy southerly swell.

"*27th.*—Wind S.S.E., squally with rain, moderate at times; course S.W. by S.; Lat. 11°.8′ S., Long, 80°.47′ E.

"*28th.*—Wind at S. by E. and S.E., 'fresh trades, squally, gloomy, rainy;' course W.S.W. Lat. 12°.20′, Long. 77°.56′.

"*29th.*—Wind S.S.E., squally. Lat. 14°.15′, Long. 75°.30′.

"*30th.*—Wind S.S.E. to S., gloomy and squally weather with rain, strong breezes, mainsail stowed, two reefs in topsails. Noon, heavy squalls. Lat. 15°.10′, Long.73°.10′.

"*31st.*—Wind S. to S.S.E., squally, and heavy rain. Lat. 15°.37′, Long 71°.20′ by Account. Sent down royal yards.

"*1st April.*—8 P.M. wind S.S.E.; 11 P.M. *south*; 2 A.M. S. by E.; 3, at *west;* 4, N.W.; 9, *north;* midnight N.E., heavy gales; at 4 P.M. lightning and thunder, incessant rain, 8 P.M. very heavy squalls, a high cross sea running; 2 A.M. very threatening; at noon split the mainsail. Lat. 15°.45′. Long. 70°.10′ E. by Account. Storm passing over the ship.

"*2nd.*—Wind N.E. and N.N.E., strong breezes, squally, a heavy sea running, ship rolling heavily and shipping water on board. Noon, more moderate. Lat. 18°.42′, Long. 69°.25′.

"*3rd.*—Wind N.E. to E., more moderate but a heavy sea running, and ship labouring much. Lat. 20°.14′, Long. 68°.16′."

H.	M.	Courses.	Wind.	Remarks.
				April 4.
2	7	WSW	East	Moderate breezes and fine weather, bent
4	7			main-topgallant-sail, main-royal-yard, and set
6	7			the sail and topmast staysail.
8	7			Ditto weather.
10	7			Throughout the night strong breezes and a
12	7			heavy swell of sea, ship rolling and labouring heavily.

CHAP. IX.

H.	M.	Courses.	Winds.	Remarks.
				April 4—*continued.*
2	7			At 2 A.M. took in the staysails.
3		W by S		At 4 A.M. ditto winds and cloudy, vessel
4	7			shipping a good deal of water; water in well
6	7			13 inches; pumped ship, sent down main-top-
8	6	West		mast-staysail-boom on deck.
10	6			Noon, breezes strong and hazy weather, ship
12	6			rolling heavily and shipping much water.
				Lat. 21°.20′, Long. 65°.30′ E. Account.
				5th April.
1	7	WSW	ENE	Strong winds and squally with rain, em-
2	7			ployed securing the hatches, &c., ship rolling
3	7			heavily and shipping a good deal of water,
4	7			took in the main-topgallant-sail. At 5.30,
5	8			increasing winds and fair weather, second reef
6	8			fore-topsail and single reef in main-topsail,
7	8		East	furled mainsail and fore and aft sails.
8	8			At 6 P.M. strong steady winds and fair
9	8			weather; down topgallant-yards and housed
10	8			topgallant-masts. Throughout the night strong
11	8			winds and fair weather.
12	8			At 4 A.M. blowing heavy with constant
				heavy rain; turned up hands, hoisted up the
1	8			foresail, close-reefed the main-topsail and set
2	8			it. At 8 A.M. increasing gales, and ship rol-
3	8			ling, and straining, and shipping a great deal
4	8			of water; furled the foresail and cleared up
5	8		ENE	the fore-topsail and furled it, and brought the
6	7			ship to under close-reefed main-topsail and fore-
7	6			topmast-staysail.
8	6			Moon, heavy gales and constant rain.
9				Lat. 22°.13′, Long. 63°.11′ E.
10		Hove-to		Captain's correction, Lat. 22°.40′, Long.
11		S S W		61°.47′. (Long. 62°.42′.)
12		,,		

Ship again overtaking the storm,

and heaving-to.

See diagram, page 218.

"*6th April.*—E., E.S.E., course S.S.W., four knots, heavy gale and violent squalls, constant rain, and thick weather, ship rolling heavily and straining, shipping seas very fast. Battened down the hatches fore and aft, and secured the ports, passed preventer-gaskets round the sails, secured boats and spars. Blew fore-top-

Sails blowing away.

mast staysail to pieces. 8, violent gales, with a tremendous sea running; 10, heavy gusts of wind; midnight, thick rainy weather, lost the jollyboat from the stern; 2 A.M. carried away the jib-boom and fore-royal-mast; daylight, moderate, cut away the wreck forward, secured the yards with preventer parcels and braces; 9·30, rolling gunwale under water, carried away main-topmast over the side, impossible to cut away the wreck, ship rolling so heavily and rolling gunwale under, hauled aft the main-trysail sheet to steady her, but the wreck soon tore it to pieces.

Tiller broke.

At 10 A.M. carried away the iron tiller of the rudder, about

nine inches from the head; got stanchions from each side, and secured it. Having no tiller or hole in the rudder-head to ship it into, hauled the driver out to keep the ship steady. At noon split the driver close-reefed to pieces, got an awning up and down the mizen rigging. Blowing most violently, with a tremendous sea, and rolling gunwales under. Pumped ship every two hours, but ship not making more than one or two inches water per hour. Threw the water-casks overboard to clear the decks.

Ship unmanageable.

"At 8 A.M. the commanding officer of the troops kindly volunteered to attend the pump, and divided his men into watches; and for that duty also stationed sentries over the hatches and lights in the gun-decks to protect the spirits and powder below. Lat. 22°.55′, Long. 60°.23′, by the Captain's Account. Wind E.N.E. to S.E. Lat. by log., 22°.23′ S. (Lat. 22°.30′, Long. 61°.20′ E.)

"*7th.*—At 2 P.M. heavy gale, ship labouring in the trough of the sea, gunwale under, not having any after-sail to keep her head to the sea.

Lying in the trough of the sea.

"At 4 P.M. *moderated a little,* occasioned her to strain very much and ship seas constantly, with heavy rain. 6 P.M. vivid lightning and very many squalls, with sudden calms for a few moments.

"At 8 P.M. *blowing violently,* fore-topsail blew adrift, ship's head W.N.W. and veered to S.W. At 10 P.M. carried away the fore-topmast, and the foresail got loose and blew to pieces.

Fore-topsail and foresail carried away.

"Midnight, blowing a perfect hurricane, with a tremendous cross sea running, and the ship rolling most violently. Raining very heavily, and constant vivid lightning during the night; ship at the mercy of the wind and waves, with the helm lashed a-lee.

"At 1.30 a furious gust carried away the mainmast close by the deck, which fell on the poop (starboard side), with the wreck of main-topsail.

Mainmast went.

"At 2.30 the mizenmast having no support, fell over the taffrail, destroying the binnacle wheel and gig on larboard quarter.

Mizenmast went.

"At 4 A.M. still blowing furiously, and ship rolling in the trough of the sea. Daylight, blowing a hard steady gale from S.W. and raining heavily. Ship labouring very heavily, and shipping seas over all. The foremast, with the wreck of the topmast, swinging about most fearfully, every moment expecting to see it go over the side, and unable to clear away any of the wreck from the violent rolling and motion of the ship. 8 A.M. hard gales from S.W. Noon, same weather, ship's head N.N.W. drifting 1½ mile per hour. Lat. 22°.23′, Long, 60°.20′ S.

Drifting round the vortex.

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"*8th.*—At 8 P.M. moderated a little, cleared away the head of the mainmast and mizenmast from the stern, and the main-topmast from the quarter, but unable to do anything with the wreck of the fore-topmast forward. At 8 A.M. got a stay and a pair of shrouds on the foremast to save it, if possible, and assist in gaining some port of safety, but could not succeed in getting them up. Sunset, still blowing a heavy gale, with a tremendous heavy sea running, and constant rain; the ship rolling fearfully in the trough of the sea, and shipping water fore and aft over all, and unable to keep the fire in for cooking for nearly three days.

Still in the trough of the sea.

"Midnight, gale decreasing, but still blowing hard, and the ship rolling heavier than ever, and quicker. A heavy cross sea running, and shipping water frequently over all. The sky breaking up and every appearance of the gale being over. Daylight, fresh S.W. winds with confused cross sea running *westerly*; got the ship's crew on the poop, and trunched the mizenmast over the stern; commenced securing the foremast with a stay and a pair of shrouds on the starboard side, the whole of them being carried away and all but the after pair on the larboard side. The carpenter fitting a preventer tiller on the rudder head, and part of the crew clearing away the wreck of the mainmast and mainyard. Noon, gale decreasing and less sea; opened the hatches, after having been battened down three days, and let in the air below, and fortunately there has not been any person seriously injured during the gale. Noon, Lat. Obs. 21°.53′, Long. 60°.37′ per Chr.

Gale decreasing.

"*9th.*—P.M., strong winds, lulls at times, with passing showers of rain; employed in securing the foremast and foreyard with a topsail sheet for a . At 8 A.M. more moderate, with passing showers of rain; bent the fore-topmast-staysail; wind northerly. Throughout the night moderate weatherly and cloudy, ship rolling heavily. Daylight, turned-to all hands, fitted lifts, &c. for the foreyard, and bent the old fore-topsail, single-reefed, for a foresail; launched the mainmast overboard, after nearly staving in the bulwarks, and got it clear of the ship, and clearing away the wreck, &c. Obs. Lat. 21°.26′, Long. 60°.21′ E. per Chr.

Clearing the wreck.

"*10th.*—Moderate, fine weather; employed clearing away the wreck, setting up the starboard foreyards, and clearing away to get the fore-topmast down on deck, which is hung and jammed well with the slings of the foreyard. 8 P.M. ditto weather, wind at north. Throughout the night, moderate and fair weather. Daylight, commenced reefing to get the fore-topmast on deck clear of the fore-yard. Noon, fine clear weather; 11 inches in well. Lat. Obs. 20°.18′ S., Long. 60°.18′ Chr.

"11*th*.—Employed about the fore-topmast. 2 P.M. succeeded in getting it on deck in safety, took off the cross-trees and purchases, secured it on deck, afterwards secured the foreyard. 8 P.M. light winds N.N.W. to N.N.E. Throughout the night ditto weather. Daylight, called all hands, reefed topsail, fore-foresail, and employed in getting the fore-topsail launched aft on the poop for the carpenters to fit as a mainmast and looking for rope for rigging. Lat. 21°.22′, Long. 60°.36′ E." Rigging jurymasts.

Extracts from the Log of the Barque ROBIN GRAY. (*Nautical Time.*)

"26*th March*, 1843.—Wind S.S.E., steering S.W., eight miles an hour, showery, fresh breezes, and squally. Lat. 8°.40′ S., Long. 79°.30′ E. Robin Gray. Chart, page 16.

"27*th*.—Wind S.E., strong breezes, a heavy *head sea* (S.W.), carrying studding sails, course S.W., eight miles per hour. Lat. 10°.30′ S., Long. 77°.30′ E.

"28*th*.—Wind S. by E., but squally, and the top-gallant-sails stowed, a turbulent sea. Lat. 12°.10′ S., Long. 75° E.

"29*th*.—Wind S. by E., strong breezes and cloudy, with a heavy swell from S., course W. S.W. Lat. 13°.20′, Long. 73° E.

"30*th*.—Wind *south*, course W. by S., six miles per hour, strong breezes and a heavy swell. Lat. 14°, Long. 70°.

"31*st*.—Fresh breezes and clear, wind S. by W. to S.W. by S., top-gallant-sails set, course W. by N. Lat. 14°.25′, Long. 68° E.

"1*st April*.—6 P.M. wind S.W., fore part fresh breezes, with a great swell from S.E.; 4 A.M. wind S.W. by W., latter part strong breezes, squally, with heavy rain; midnight, double-reefed topsails; noon, blowing strong, close-reefed topsails. Lat. 14°.30′, Long. 67°.20′.

"2*nd*.—4 P.M. wind S.W,, blowing hard, with heavy squalls and 'torrents of rain,' the sea high and cross; 8 A.M. wind W. by N.; vessel labouring heavily and shipping a great deal of water. Lat. 15°.45′, Long. 67°.20′. Storm overtaking the ship.

"3*rd*.—Wind N.; scudding; heavy rain, squally, and a high cross sea. At noon, the wind N.N.E., under reefed foresail and close-reefed top-sails; course S. by W., seven miles per hour. Lat. 18°.20′, Long. 65°.30′.

H.	K.	Courses.	Wind.	Remarks.
				April 4.
4	8	S W by W	N E	Scudding all day, blowing a strong gale,
8	8			with showers and squalls, and the sea run-
12	8			ning very high all the twenty-four hours;
				down royal yards. Midnight, close-reefed
4	8			the main and stowed the fore-topsail. At
8	8			A.M. set the close-reefed fore-topsail. Noon,
12	8			cloudy weather and blowing hard; double-
				reefed the mizen, stowed the jib, &c. Sun
				obscure.
				Lat. 20°.30′ S., Long. 63°.20′ E. by account.
				April 5.
2	9	S W by W	N E	Scudding; strong gales with cloudy, rainy
4	9			weather and a very high sea. 4 P.M. reefed
6	9			the foresail. 10 P.M. the wind increasing,
8	9			with severe squalls; stowed the fore-topsail.
10	9			Midnight, stowed the foresail; the gale still
12	9	.....	East	increasing, with dark rainy weather. 4 A.M.
				the wind and sea increasing fast. About
2	9			noon, blowing to an awful extent; made an
4	9			attempt to take in the maintopsail, when it
6	9			blew to atoms; running about 8 or 10 knots
8	9	N W	S E	without a sail set.
10	9			The sea making a breach at times over the
12	9			vessel, a deal of the bulwarks carried away,
				and one of the guns overboard; long-boat
				full of water and the stock drowned; the
				pumps carefully attended. Sun obscure.
				Lat. 21°.30′ S., Long. 60°.45′ E.
				April 6.
2	9	N W	S E	Scudding. 4 P.M. the wind veering round
4	9	Before the wind	,,	to the southward, and blowing still the same.
				About 6, round to S.W., *lulled a little for*
6	9	,,	S W	*a short time. The sky looked rather finer,*
8	9	,,	West	when, presently, it assumed a wilder aspect
10	8	,,	N W	than ever, and blew a hurricane, always keep-
12	8	,,	North	ing right before the wind, and it still veering
2	8	,,	N E	round towards the westward. At 8 P.M. the
4		Lay-to		weather the same, the wind veering round to
6		N W		the N.W.W. Midnight, very squally, with a
8				deal of lightning and heavy showers, the
10				wind veering round to the northward, run-
12				ning right before it. 2 A.M. the vessel
				broached-to, and the helm lost all power over
				her, the wind about N.E., and her head to the
				N.W., blowing still, and awfully dark, the
				ship almost on her beam-ends, and the sea
				flying right over her. 4 A.M. the wind and
				weather the same. At daylight, more mode-
				rate, with a very high sea; found our bul-
				warks and other things very much damaged.
				Noon, more moderate and raining heavily;
				the pumps carefully attended.
				Lat. 22°.02′ S., Long. 61°.50′ E.

Scudding in the midst of the storm.

Getting before the vortex,

and

scudding round it.

See diagram, page 218.

Extracts in full—continued.

The wind was most severe on the night of the 6th, but the sea was most heavy and the lightning more terrific on the night of the 7th.

H.	K.	Courses.	Wind.	Remarks.
				April 7.
2 4 6 8 10 12 2 4 6 8 10 12	..	.....	N E	Cloudy, rainy weather, with a very cross sea. 4 P.M. the ship's head round to the southward; the double-reefed mizen, fore-spencer, and reefed foresail set. 8 P.M. the wind increasing and the night looking bad; stowed the foresail. About 10 P.M. blowing strong, with a very high turbulent sea, the ship labouring very heavily and making a deal of water; all hands at the pumps. Midnight, dark and blowing hard, awful sea, with a deal of thunder and lightning; the fore-spencer blown to pieces and the mizen split. About 2 A.M. the tiller-chains broke, got them secured again, the pumps still gaining on us, all possible exertion used. Daylight, wore ship, in hopes that she would make less water in the other tack; some hands at the pumps, others driving oakum in about the stancheons; from four to five feet of water in her. About 10 or 11 A.M. got it to 18 inches. Noon, pumped dry as possible, blowing heavy, with rain at times; the spritsail-yard, jib-boom, guy's back ropes, lower booms, and most of the gear about the bows cut, broken, and washed away, with a great deal of our rigging and gear aloft cut and useless. The master protests against all damages the ship and cargo have sustained by the said gales.

A very cross sea.

Tiller chains broke.

H.	K.	Courses.	Wind.	Remarks.
				April 8.
2 4 6 8 10 12 2 4 6 8 10 12				First part of the day, strong gales with rain, latter part more moderate. At daylight, set the foresail and fore-top-sail, and afterwards bent the main-spencer for a storm trysail; the mizen-boom broken, bent another main-topsail, clearing up the wreck, and bore up for Port Louis for the safety of the ship and cargo. Lat. at noon, Ob. 22°.5′ S., Long. Ch. 61°.00′ E.

Bore up for Port Louis.

"*9th April.*—Wind N.W., squally, with showers, but moderate. Lat. 22°, Long., 60°.30′.

"10*th.*—Wind N.W. to N., light winds, and latterly calm fine weather. At noon saw the Waverley. Lat. 21°.30′, Long. 60°.12′."

CHAP. IX.

Extracts from the Log of the Ship BROXBOURNBURY, *(Nautical Time.)*

Brox-bourn-bury. Chart, page 15.

23*rd March*, 1843.—Wind W. to W. S.W., course S.E., fresh breezes and squally. Lat. 6°.5′ S., Long. 78°.50′ E.

"24*th*.—2 P.M. wind S.W. by W., squally, with rain; at 4, hard squalls and incessant rain; at 6, wind variable; at 8, wind E.N.E.; at midnight, wind W. S.W.; at 4 A.M. W.N.W.; at 10, W. Lat. 7°.28′ S., Long. 79°.10′ E.

"25*th*.—2 P.M. wind at W. S.W., variable breezes, gloomy weather, and occasional squalls; at 8 P.M. calm; at 2 A.M. wind S.S.E.; at 10, wind S. Lat. 7°.47′ S., Long. 79′ E.

"26*th*.— 2 P.M. wind S. by W., unsettled and squally, fresh breezes, and *two reefs* in the topsails; at 8 P.M. wind S.W. by W. Noon, wind S. by E. Lat. 8°.52′, Long. 79°.10′ E.

"27*th*.—Wind S.E., and course S.W. by S.; strong breezes and cloudy. Lat. 10°.20′, Long. 78°.28′ E.

"28*th*.—2 P.M. wind S.E., fresh breezes and hard squalls, with lightning to the westward. 4 A.M. wind S.E. by S., two reefs in the topsails. 8 A.M. S.S.E. Daylight, heavy squalls, sent down the royals. Lat. 12°.22′ S., Long. 76°.7′E. Course S.W. by S., seven miles

"29*th*.—[*In front of the gale*,*] 2 P.M. wind S.E. by E., strong breezes, squally, with rain. 12, S.S.E., steering S.W. 6 A.M. wind S. by E., steering S.W. by W. Lat. 14°.10′, Long. 74°.32′.

"30*th*.—2 P.M. wind S. by E., course during the twenty-four hours W. S.W., seven miles per hour. 2 A.M. wind S., a fresh gale, squally, cloudy and heavy sea with much rain. 4 A.M. S. by W., two reefs in the topsails; 10 A.M. south, mizen-top-gallant-yard sent down. Lat. 15°.3′, Long. 72°.21′ E.

Storm overtaking and passing over the ship.

"31*st*.—[*Diverging from the vortex*,] wind S., ship steering W. by S. ½ S. After midnight, violent squalls, ship straining heavily and shipping a good deal of water; three reefs in the topsails; and at noon, Lat. 15°.17′, Long. 70°.24.

1*st April*.—[*North of the focus*,] fresh gales, squally, with rain. A.M. Heavy squalls, with rain and lightning; increasing appearance of bad weather, stowed fore-topsail, close-reefed main-topsail. 2 P.M. wind S., course W. S.W. 12, wind S. by W., course W. by S. 4 A.M. wind S. S.W., course W. by N., moderate, and lightning all round. Noon, S.W. by W., moderate and thick, sent down top-gallant-yards. Lat. 15°.19′, Long. 69°.25′.

* The remarks in brackets are Mr. Thom's.

Extracts from the Log of the Ship BROXBOURNBURY—*continued.*

"*2nd.*—[*Behind the centre,*] fresh gales and thick weather; 5 P.M. a heavy squall from N.W.; 6, wind S.W. by W., course W. by N.; 8, wind N.W., course S.E., strong gales, ship straining and labouring much; 10, wind N.W., course S.W. by S. 5; 12, wind N.W., course S.W. 6; fresh gales, heavy rain, a swell from S.S.W., making the ship very uneasy; 8 A.M. wind N.N.W., course S.W. by W. 7; at daylight set the mainsail; 10, wind N.N.W.; noon, strong breezes. Lat. 16°.31′, Long. 68°.19′.

H.	K.	M.	Courses.	Wind.	Remarks.	
					April 3.	
2	6		S W by S	N N W	Begins with fresh beezes and cloudy,	Ship behind the storm,
4	6		.'..	N N W	people employed as most useful. At	
6	6		....	North	4 P.M. ditto weather, stowed the mizen-	
8	6		....	N E by N	topsail. At 8, strong breezes and clear,	
10	6		S W	N E	in mainsail, pumped ship at seventeen	
12	6				inches. Midnight, fresh breezes and squally, with light showers of rain.	
2	6				A.M. Ditto weather, strong breezes and	
4	6				cloudy. Daylight, set main-top-gallant-	
6	6				mast, pumped ship every two hours. At	
8	6				8, strong breezes and cloudy, shifted the	
10	6				third fore-topsail, with second main-	
12	6				topsail, with best one. Noon, fresh breezes with hazy weather.	
					Lat. 16°.31′ S., Long. 66°.57′ E.	
					Bar. 29·66 to 29·42.	and
					April 4.	
2	6	4	S W	N E	Begins with moderate breezes from	
4	6	4			west, people employed repairing the	
6	6	4			main-topsail. At 4 P.M. ditto weather;	
8	7	4		N E by N	5, up main-top-gallant-yard; at 6, set	again overtaking the storm.
10	8				ditto; 10, close-reefed the fore-topsail.	
12	8				Midnight, heavy squalls, with rain, took in main-top-gallant-sail, in three reefs	
2	8				main-topsail. A.M. Squally, with light-	
4	8				ning. At 4, ditto weather, with passing	
6	7				showers, heavy sea running and ship la-	
8	7				bouring much. Daylight, ditto weather,	
10	8				pumped ship every two hours. At 8,	Diagram, page 218.
12	8				strong gales and squally, ship rolling heavily, taking much water on deck. At 8.30, watch employed in sending down main-top-gallant-yard, and housed the main-top-gallant-mast and flying jib-boom. Noon, strong gales and heavy squalls; ship straining and rolling heavily, shipping a great quantity of water on deck.	
					Lat. 20°.45′, Long. 65°.18′ E.	
					(Lat. 20°.42′, Long. 64°.50′ E. Capt. Burnett's correction.)	

CHAP. IX.

Extracts from the Log of the Ship BROXBOURNBURY—*continued.*

	H.	K.	M.	Courses.	Wind.	Remarks.
						April 5.
Running in front of it.	2	8	..	S W	N E by E	Begins with strong gales, and heavy squalls passing. At 4, heavy squalls with rain, ditto weather, pumped ship at ten inches. Midnight, heavy squalls with rain. A.M. Ditto weather, in foresail, heavy gale and increasing, close-reefed the main-topsail, ship labouring heavily, shipping much water on deck. 4.30, Mr. Fleak died on board. At 5, heavy gales, ship labouring heavily, in topsails, ship scudding under the top and lower masts, and straining and labouring very heavily, and shipping heavy seas on deck, pumped ship every half hour. At 10, hove-to under *the masts*, ship labouring heavily. Noon, heavy gales with a heavy sea, and incessant squalls with rain. Lat. 22°. 49′, Long. 63°. 16′ E. (Lat. 22°. 20′ S., Long. 62°. 30′ E.?) Bar. 29·30.
	4	8				
	6	8				
	8	8				
	10	8	..	W S W	E N E	
	12	8				
	2	8	..	West		
	4	8		....	East	
	6	8				
	8	8				
	10	7	4			
	12					
Hove-to.						
						April 6.
	2	..	..	S S W	East	Begins with heavy gales and violent squalls, with heavy rain, ship lying-to under the above masts, and straining and labouring heavily, and shipping a great deal of water, a heavy sea running. At 8, ditto weather, ship labouring heavily. At 10, ditto weather, pumping ship constantly, four feet ten inches in the well. Midnight, heavy gales and violent squalls, ship labouring heavily. At 1.30 A.M. shipped a heavy sea, and took away the gig and the lower quarter gallery on the starboard side, and some of the bulwarks on the lower side. At daylight, ditto weather, with violent squalls and incessant rain, ship labouring and striking heavily on the starboard side, shipping heavy seas on deck, washed away the starboard anchor. At 10, cast the corpse of Mr. Fleak to the deep. At 11.20, washed away the remainder of the bulwarks of the main deck on the starboard side, all the crew employed in pumping constantly. Noon, more moderate, and incessant rain, ship labouring heavily. Lat. 22°. 49′, Long. 62°. 50′ E. (Long. 61°. 40′ E.?)
	4				E S E	
	6					
	8					
	10					
	12	..	..	South	East	
						April 7.
	2	..	..	South	E S E	Begins with a heavy hurricane from the S.E., ship straining and labouring and shipping heavy seas on deck, all hands employed pumping ship, ship making much water. 4 A.M. ditto wea-
	4					
	6					
	8					

Extracts from the Log of the Ship BROXBOUNBURY—*concluded.*

H.	K.	M.	Courses.	Wind.	Remarks.	
					April 7—*continued.*	
10					ther, with violent squalls and heavy rain.	
12					At 8, ditto weather, ship striking very heavily abaft. Midnight, ditto weather,	
2					with a heavy sea running. 3 A.M. ship	
4	..	..	N E	S E	wore round on the starboard tack,	
6					carried away the cutter from the larboard-quarter, larboard bulwarks and stanch-	
8					eons, and on main deck, all hands at	
10					the pumps. Daylight, ditto weather,	
12	..	..	....	S S E	larboard gun washed away. Noon, heavy hurricane, ship can no longer lie-to, kept away before the wind to save ship and crew. Passed a vessel (the Waverley) with her foremast and main-topmast gone, bearing S.E.	
					Lat. 22°. 56′, Long. 62°. 4′ E. (Lat. 22°.35′, Long. 61°. 35′, per Captain's corrections.) (Long. 60°. 40′ E.?)	
					Bar. 29·30.	
					April 8.	
2	7	..	North	S S E	P.M. Begins with a heavy hurricane	Drifting round the storm.
4	7	..	....	South	from S.E. to S. and S.W., all hands em-	
6	7				ployed at the pumps, ship straining and	
8	7				labouring heavily, shipping heavy seas on	
10	5				deck. At 3.30, John Hugre, boatswain,	
12	5	..	....	S W	washed overboard from the larboard-channel, no assistance could be given,	
2	3	4			all our boats are washed away from	
4	3	4	N W		quarters, the larboard anchor washed	
6	3	4			overboard. 6, ditto weather. 8, moderate,	
8	3	4			with violent squalls, set the main-topsail.	
10	3	4			Midnight, more moderate, with rain and a	
12	3	4			heavy swell from the south, ship rolling heavily, all hands employed pumping ship. At 4 A.M. set the foresail, jib, and mizen. At 8, fresh breezes and squally, with rain. Noon, ditto weather. Sick list: Mr. Connor, second officer, John Ritwood and John Boode, seamen. At 12, cast the corpse of Allan Morne to the deep.	
					Lat. 21°. 16′ S., Long. 62°. 24′ E.	
					Lat. 21°. 32′, Long. 60°. 12′, Captain's correction.	
					April 9.	
2	3	4	N W	S W by S	Begins with moderate breezes and	
4	3	4			squally, with rain, watch employed at	
6	3	4			the pumps, bent the best fore-topsail and	
8	3	4			staysail. At 8, ditto weather, with a swell	
10	3	4			from the south. Midnight, ditto weather.	
12	3	4			A.M. Ditto weather. Daylight, ditto weather, with passing showers, out all reefs	
2	3	4			mizen-topsail. 8, moderate and squally,	
4	3	4			with passing showers. Noon, moderate,	
6	3	4			fine weather.	
8	3	4	W N W		Lat. 20°. 13′ S., Long. 59°. 35′ E.	
10	3	4	W N W			
12	3	4				

CHAP. IX.

"10*th April*.—Wind W. S.W., W.N.W., the gale over; '*spoke the Velore at* 3 P.M.' Lat. 59°.19′ S., Long. 20°.45′ E.

"11*th*.—Wind W.N.W., N.N.W., N., fine weather and light breezes. Lat. 20°.35′, Long. 29°.2′ S.

"12*th*.—Wind N.E., sighted Mauritius."

Extract from the Log of the Ship MARGARET. (*Nautical Time.*)

Margaret. Chart, page 15.

"27*th March*, 1843.—Squally and fresh breezes, a heavy sea and a good deal of lightning, wind N.W. Lat. 9° S., Long. 73°.41′ E.

"28*th*.—The wind variable and light. Lat. 9°.37′ S., Long. 72°.87′ E.

"29*th*.—Wind S. by E., squally, heavy rain and 'dark threatening appearance.' Lat. 10°.46′, Long. 70°.23′ E.

"30*th*.—Light and variable wind. Lat. 11°.29′, Long. 68°.15′ E.

"1*st April*.—Wind S. to S.W., cloudy and heavy rain. The weather squally and *a heavy head* (S.E.) *sea running*. Lat. 13°.2′, Long. 65°.30′.

Entering the storm.

"2*nd*.—The wind S., veering to W.S.W. 'Threatening looking weather,' squally, ship pitching heavily and shipping seas, vivid lightning. Lat. 14°.32′, Long. 65°.56′ E.

"3*rd*.—Wind at 1 P.M. W., light breeze at first; at 12 P.M. W.N.W., squally, and wind increasing; at 8 A.M. N.W., stormy, dark and lowering, rain and lightning from westward. Lat. 16°.38′, Long. 65°.30.

H.	Courses.	K.	F.	Winds.	Remarks.
					April 4, 1843.
2	S W by S	9		N W by N	These twenty-four hours commencing
4		10			with fresh gales and constant rain; the
6		10			ship rolling and labouring heavily. At
8		10	4		4 P.M. sent down the topgallant-yards. At
10		10	4		8, the ship labouring and straining much;
12		10			reefed the foresail and topsail. At mid-
					night do. gales and heavy rain. 4 A.M. do.
2	S W by W	10		N W by N	weather. At noon, strong gales and heavy
4		10			rain; the ship rolling and pitching heavily,
6		10			the people attending the pumps. (Running,
8		10	4		but blowing strong gales of wind.) The
10		10	4	Variable.	sun obscured.
12		10	4	do. N N E	Lat. 19°.54′ S., Long. 64°.22′ E.

Behind the centre,

but scudding, and overtaking it.

Extracts from the Log of the Ship MARGARET—*continued.* CHAP. IX.

H.	Courses.	K.	F.	Winds.	Remarks.	
					April 5.	
2	S W	9	4	N E	These twenty-four hours commencing	
4		9	4		with strong gales and a heavy cross sea,	
6		10			the ship labouring and straining very	
8					much. At 8 P.M. the gale increasing, and	
10					the sea getting very high, handed the fore-	
12					topsail and foresail, and hove the ship to	
					under close-reefed maintopsail. At 10.30	
2					P.M. a heavy sea broke on board and carried	
4					away the troops' cook-house and coppers,	
6					the larboard lower studding sail-boom, and	
8					a quantity of the ship's stores. At mid-	
10					night, strong gales and heavy rain attended	
12					with thunder and lightning, the ship	
					making much water through the decks	
					and top-sides. At noon, ditto gales, the	
					people attending the pumps, the ship's	
					head up to N.N.W., and off to N.W.	
					More severe, hove the ship to at dark, sea	Hove-to.
					running high. Sun obscure.	
					Lat. 21°.32′ S., Long. 63°.15′ E.	
					April 6.	
2	Up to				These twenty-four hours commencing	
4	N N W			N E	with strong gales and hard squalls of wind	
6	off to N W				and rain. At 5 P.M. the ship, when pitch-	
8					ing heavily, was struck by a heavy sea,	
10					which carried away the jib-boom and bow-	
12					sprit shrouds; the wreck was obliged to	
					be cut away with the loss of the jib and	
2					flying-jib for the safety of the bowsprit.	
4					At 10 P.M. the gale increasing, and the sea	
6					very cross and breaking heavily on board;	
8					carried away the coops and live stock. At	More mo-
10	S W	9	4	N E	midnight, ditto gales. At 8 A.M. more	derate,
12		9	4		moderate, made sail, set the topsail and	and made
					foresail, *and let a reef out of the main-top-*	sail.
					sail. At noon, strong gales and heavy	
					rain, the ship rolling heavily and making	
					water, the pumps well attended to. Sun	
					obscure. Hurricane heavy still.	
					Lat. 22°.8′ S., Long. 62°.52′ E.	
					April 7.	
2	S W by S	9	4	N E by N	These twenty-four hours commencing	
4		10	4		with strong gales and a heavy cross sea,	
6		10	4		the ship rolling and straining much. At	
8		10	4		4 P.M. the gale increasing, close-reefed the	
9	Hove-to				topsails and reefed the foresail. At 9 P.M.	
10	N N W				the trusses of the fore-yard broke, hauled	
12	to N W			Variable.	up the foresail and hove the ship to, the	Hove-to
					fore-topsail having been blown to pieces	again.
2					at the same time. At 10 P.M. the gale in-	

CHAP. IX.

Extracts from the Log of the Ship MARGARET—*continued.*

H.	Courses.	K.	F.	Winds.	Remarks.
					April 7—*continued.*
4					creasing to a hurricane. At midnight, the
6					main-topsail was blown from the yard and
8					the mainsail from the gaskets when furled,
10					set the spanker, close-reefed. At 2 A.M.
12	.....	..	..	S S W	the spanker was blown to pieces, the sea breaking on board and the ship labouring and straining and making much water, the pumps constantly going. At 2.32 A.M. a heavy sea broke on board and carried away the long-boat and pinnace from their chocks and stove them to pieces, at the same time carrying away and drowning all the live stock, say sheep, pigs, and poultry, also carrying away the ship's cooking-houses and coppers, a number of water-casks and buckets. At 4 A.M. bent a new storm-staysail to the mizenmast. At 5 A.M. the ship was struck by a heavy sea on the quarter, which carried away the rudder, broke a plank in the counter and the head of the stern-post, carried away the round-house and a quantity of paints and oil, at the same started her cargo, ship's stores, and a tier of water-casks in the hold. Found it necessary, for the safety of the ship and masts, to cut away the fore and main yard, which were broken from their trusses, together with the studding-sail, booms, and gear belonging thereto; both pumps, with much exertion, enabled us to keep the ship clear. At noon, hurricane strong from the S.S.W. with heavy rain and lightning, the ship labouring and straining very much, and carrying away the lower rigging and brace back-stays, and opening her water ways, both pumps constantly going. Hurricane more violent when the wind shifted to the S.S.W.
					Lat. 22°.19′ S., Long. 60°.20′ D.

A hurricane.

Rudder gone.

Drifting round the vortex.

H.	Courses.	K.	F.	Winds.	Remarks.
					April 8.
2	W N W			S W	These twenty-four hours commencing
4	to N W				with strong hurricane and heavy squalls
6	by N				of wind and rain, attended with thunder
8					and lightning, the people constantly at the
10					pumps. At 6 P.M. ditto weather. At mid-
12					night, the sea breaking very high over all.
					At 2 A.M. the quarter-boat and davits were
2					carried away by a heavy sea, and part of
4					the bulwarks. At 8 A.M. the hurricane
6					not so violent. The carpenter, with all
8					assistance, making the necessary prepara-
10					tions for the construction of a new jury-
12				S W by W	rudder. At noon, ditto weather, with hard squalls of wind and rain, hurricane still violent, the ship's head up to N.N.W., and off to N.W. by N. Sun obscure.
					Lat. 22°.8′ S., Long. 60°.30′ E.
					April 9.
2	W by N			S W by S	These twenty-four hours commencing
4	N W				with strong gales and hard squalls of wind
6					and rain, the sea running very high, the
8					ship straining and making much water,
10					the people clearing away the wreck and
12					pumping the ship. At 4 P.M. bent a new

Sea breaking over all.

Extracts from the Log of the Ship MARGARET—*continued.*

H.	Courses.	K.	F.	Winds.	Remarks.
					April 9—*continued.*
2					spanker, and set it close-reefed. At 8 P.M.
4					sudden gusts of wind. At midnight, still
6					squally and sudden gusts of wind. At 8
8					A.M. more moderate, the people sending
10					down the topsail-yards and fitting them
12					for lower yards. At noon, squally weather
					and a heavy sea, the pumps kept con-
					stantly going, the carpenter at the rudder,
					weather moderated but little.
					Lat. Obs. 21°.19′ S., Long. 61°.10′.
					April 10.
2	NW by N			W S W	These twenty-four hours commencing
4	to				with squally weather and high sea. At 8
6	N N W				P.M. ditto weather and squally. At mid-
8					night blowing fresh and the ship rolling
10					much and making water. At 8 A.M. more
12					moderate, the carpenters making a jury-
					rudder. At noon, fair weather and a high
2					sea, the pumps well attended to, people
4					employed rigging the ship. The ship still
6					without a rudder.
8					Lat. Obs. 21°.5′ S., Long. per Chron.
10					60°.30′ E.
12					
					April 11.
	N E			N W	Fair weather, a heavy swell, rudder not
					yet ready.
					Lat. 21°.21′, Long. 60°.43′ Chron.
					April 12.
	N W			S E	Light wind, rigging jury-rudder.

Value of Mr. Thom's work.

The commander of every ship making a voyage to the Indian seas would do well to be acquainted with Mr. Thom's account in detail of the Rodriguez hurricane, and to read his practical observations (Section VII.), which point out how those vessels might have avoided the heart of the storm.

On a chart of the Indian Ocean, prefixed to Mr. Thom's work, he has laid down the tracks of thirty-three storms, and published, in an abridged form, the data for the courses assigned to each. These courses present a series of curves, nearly parallel to each other,

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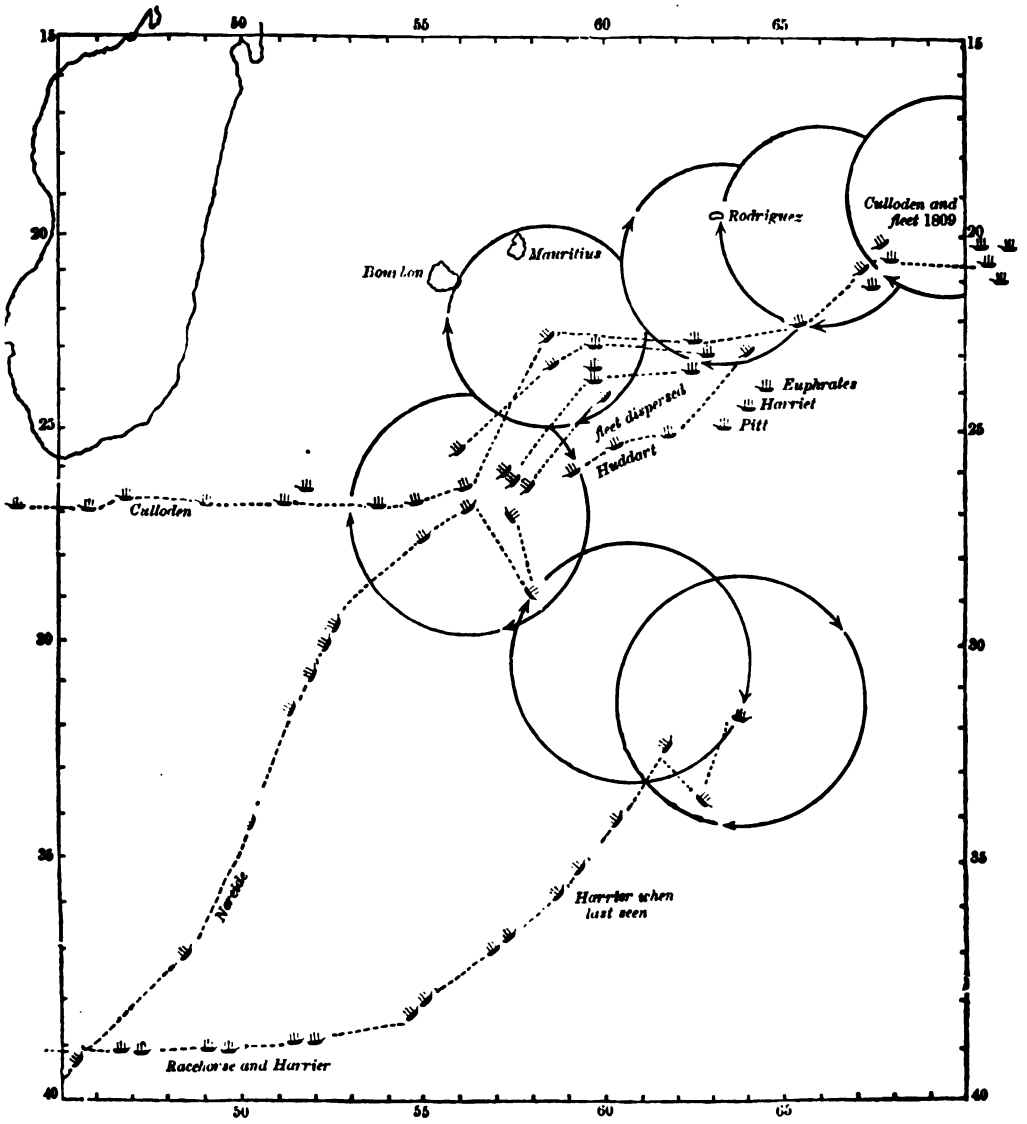
showing that storms of the Indian Ocean generally follow similar tracks. Although many of these depend on reports from the log-books of single ships, they are, nevertheless, when taken collectively, of much value.

Some of these storms have been traced as far as the twenty-fifth degree of south latitude, where storms begin to recurve. When Mr. Thom's chart of the Indian Ocean is compared with Mr. Redfield's for the North Atlantic as far as the twenty-fifth degree of latitude, the counter-movements of the storms of the two hemispheres are very striking. If the chart of the North Atlantic storms, given in this volume, be folded at the twenty-fifth degree of latitude, and, after being reversed, held up to the light, it will present a strong resemblance to the storm tracks on the chart of the Indian Ocean. It can hardly be doubted that, if means had existed to track the Rodriguez and other hurricanes beyond the thirtieth degree of latitude, that they would have been found recurving in the contrary manner to the gales of the North Atlantic, and in the same manner as the Culloden's storm. A chart of the Culloden's storm, on a reduced scale, is given on the opposite page.

Ships overtaking storms.

Many instances are now known of ships on their homeward voyage across the Indian Ocean, falling into storms, and, after having dropped behind them, having again overtaken the same storm, and got into it a second time by making sail. The risk of this occurring will be greater about the twenty-fifth and thirtieth degree of latitude, owing to storms there recurving, which will be further alluded to when treating of storms in high southern latitudes. I think it probable, that a south-westerly or westerly swell may serve to give



some degree of warning of this danger, although in the recurving of a gale the sea may be expected to be confused.

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The next figure represents a ship sailing W. S.W.,

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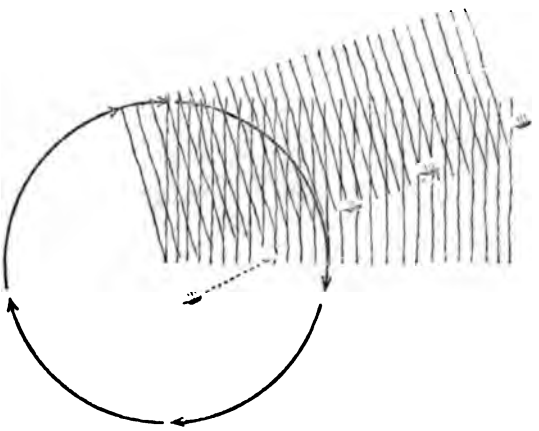
supposed to be meeting a gale in the southern hemisphere recurving. A ship in the first position, with the centre of the recurving gale somewhat more south than the ship's position, would, I suppose, have a south-westerly swell predominating.



This swell would become more westerly if the ship should make more southing than the storm. On coming within the circuit of the gale, the ship would have northerly winds; and by sailing on she might get before the gale's centre. But by changing in time to the port tack, and standing northward, she would avoid the strength of the gale, and she would come up as the northerly wind veered to the west and south-west.

CHAPTER X.

THE RESULT OF OBSERVATIONS AT THE BERMUDAS, AND ON DIVIDING WEATHER TABLES ACCORDING TO BAROMETRIC OSCILLATIONS.

By studying tropical hurricanes, and tracing them into higher latitudes, it has been ascertained that the extra tropical gale is not unfrequently the tropical hurricane. We are led next, in natural order, to study the gales in those latitudes just outside the tropics, called the Variables, on the northern border of which lie the Bermuda Islands.

The Bermudas are in Lat. 32° N., Long. 64° W. The revolving winds which pass over them are of various degrees of force, from breezes to storms. In the summer season the winds there are light, and usually steady for a considerable time, blowing in straight lines and without veering, with little fluctuation in the barometer. But after the commencement of November, veering winds of various degrees of force set in, and gradually become frequent; yet they seldom follow in such rapid succession as that one gale becomes confounded with another. Light winds and very fine weather usually intervene between the passage of revolving winds; while, at other times, hard blowing straight line winds, with a high barometer, intervene. The arrival of each succeeding progressive circuit of the wind is indicated by the barometer falling, as well as by the increase of the wind's force. Each oscillation of the

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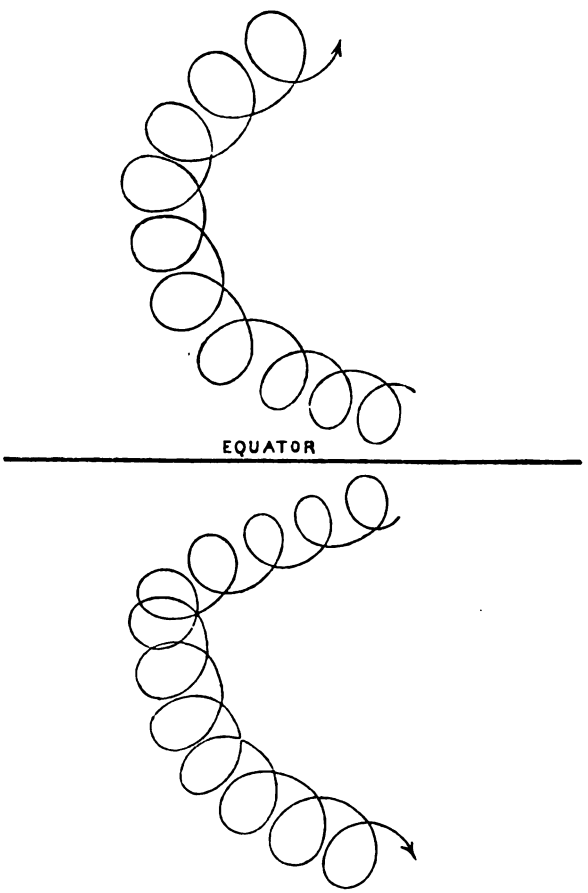
barometer should be separately studied. This is the mode I have long followed: instead of dividing the following tables of the weather periodically, they have been *divided according to barometric oscillations*, that being the mode best suited for the study of the Variable Winds.

Except in the case of great storms, perfect regularity in the fall and rise of the barometer, and in the changes of the wind, will not be found. For the direction of the wind, as well as the atmospheric pressure, is, no doubt, modified by other revolving gales or strong winds blowing at the same time: but when whirlwind tempests blow, they overpower such irregularities.

In high latitudes, westerly gales are much more frequent than easterly gales. This may, perhaps, be owing to the general atmospheric current being westerly. If, for example, we suppose this general westerly straight-line wind to be expressed by the No. 4, and the force of the wind in a whirlwind also to be expressed by the No. 4, the east wind of the whirlwind will exactly balance the straight-line west wind of the general westerly current, so that a calm would result. But on the opposite side of the whirlwind, the wind's force would be doubled, and amount to a gale.

In a progressive whirlwind, the wind on one side would be carried on faster than on the other, in proportion to the rate of the gale's progression. When the course of a gale in high latitudes is towards the N.E. the south-west wind of the whirlwind would be accelerated beyond the rate of the N.E. wind. An inspection of the figure repeated here will assist this explanation:—



I shall now give copies of some of the tables of the weather, recorded at Bermuda, and published there in the *Bermuda Royal Gazette.*

I shall endeavour to indicate the direction in which some of the revolving winds passed over Bermuda, according to these tables, by drawing an arrow across a circle. That part of the revolving breeze or gale cut by the arrow or spear, signifies the chord of the circle of the whirlwind passing over those islands. But when the wind veers round and makes a complete circuit, as

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it often does at Bermuda, it is not easy to fix upon the exact point at which the new progressive circuit begins. The lighter the revolving breezes blow, the more difficult it is to fix this point.

When the exact points at which a gale begins and ends can be distinguished, the veering of the wind during the gale will be shown by the line which connects these points.

*Weekly Report of the Weather, recorded at the Central Signal Station, at Government House, Bermuda.—Height above the Sea, 134 feet.**

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839. Oct. 26	Noon	E by N	2	g	33·0	74	Thunder in the E. at 9.20 A.M. Frequent showers. Wind veering to S.E. at 10 P.M.
				Revolving Wind.			
26	P.M. 10	S E	1	b	30·01	75	Lightning in the W. at 10 P.M.
,,	Midnight	S E	1	c	30·03	76	
27	Noon	S E	3	c	30·04	76	
28	,,	S S E	5	c	29·88	73	
29	A.M. 6	S S E	5	g r	29·75	77	Rain. Weather threatening.
,,	Noon	E	5	m r	29·65	77	
,,	P.M. 2	N E	6	m o	29·54	76	Wind veering to N. by the E.
,,	,, 7	N by E	6	u	29·44	76	Threatening appearance of the weather.
,,	,, 9	N	7	o u	29·40	76	Bar. falling and wind rising.
,,	,, 11	N	7	o	*29·32	75	Wind full N. at this hour.
30	Noon	N by W	5	c	29·45	75	
31	,,	W by N	2	b v	29·77	76	High sea to eastward of North Rock.
Nov. 1	,,	W	3	c v	29·80	76	
2	,,	N by W	2	b c m	29·7	74	
,,	Midnight	W	2	m r	29·7	74	Lightning in the E. at 6 P.M. Rain during night.
3	Noon	N W	1	g m	29·82	74	Weather very misty at 2 P.M.

* These tables are not corrected for altitude.

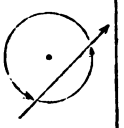
The 4th and 5th of Nov. were days of light fluctuating winds.

Light Fluctuating Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Nov. 4	A.M. 10	S by E	2	o r	29·77	74	Distant thunder in the S.
,,	Noon	,,	,,	,,	,,	,,	
5	,,	N N E	1	b v	29·82	75	Rain at 7 A.M.

On the 7th the wind veered round faster than the barometer changed. The sea was breaking high on the North Rock, an indication of stormy weather to the northward; and this may have been the cause of the wind changing earlier to W.N.W. than the barometer indicated.

Revolving Wind.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Nov. 6	Noon	S W	4	b v	29·88	77	Sea breaking high on North Rock.
7	,,	W N W	5	m q r	*29·83	76	Heavy squall at 7 A.M. Distant thunder in S.E. at 11. 45 A.M.
8	,,	W N W	5	c m q	29·87	74	Squall at 2 P.M. 
9	,,	W N W	3	c r	29·98	70	
,,	P.M. 11	W by N	1	o l	29·95	69	Lightning in the W.. and the whole sky covered with impervious clouds.

In the winter season, at Bermuda, northerly winds sometimes blow hard, without veering for two and three days together. These I considered as straight-line winds not revolving. During the time they blew,

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the air was both dry and cold; and whilst the thermometer fell, the barometer either remained stationary or else rose a little. The 10th, 11th, and 12th of Nov., of 1839, afford an example of such a wind blowing from the north-west. This was satisfactorily proved at the time by the arrival of H. M. S. Andromache, from New York:—

Straight-Line Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839. Nov. 9 and 10	Midnight	W by N	4	o l	29·94	68	Lightning in the W. Sea roaring loud on the S. side.
10	A.M. 7. 30	N W	5	g m q	29·82	68	Distant thunder, N.W.
,,	Noon	N W	6	p q v	29·87	67	Sea breaking high on North Rock.
11	,,	N N W	5	c p q	29·87	63	Sea breaking high to E. of North Rock.
12	,,	N N W	5	c q	30·02	64	

In the next circuit of wind immediately following this hard blowing N.W. wind, the barometer rose, indicating increasing atmospheric pressure over Bermuda. The revolving wind blowing at S.E. encountering and reversing the former gale at N.W., might be sufficient cause for this increased atmospheric pressure.

Misty weather, noted on the 13th of Nov., is very uncommon at Bermuda; but it constantly happens that a change of weather is first announced by increase of both temperature and moisture in the air. The warmer air from the side of the tropic not unfrequently seems to mingle with the cooler air from the north, so as to be sensibly felt, before the southerly wind of a

new circuit has gained sufficient force to reverse the last of the northerly breezes.

Revolving Wind.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Nov. 13	Noon	S S E	1	m o r	29·94	64	Misty, so as to interrupt view.
14	,,	,,	4	c b	30·02	69	Sea breaking high on North Rock.
15	,,	S E by S	5	b v	30·19	75	Sea roaring loud in the S.E. at 9 P.M.
16	,,	S S W	4	b c	30·24	74	
,,	Midnight	S W	1	b v l	30·12	73	Lightning in the S.E.
17	Noon	W N W	1	b c	30·16	74	

The five days, from the 18th to the 22nd inclusive, present an anomalous state as regards the changes of the wind:—

Fluctuating Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Nov. 18	Noon	S W by W	4	p q	29·97	73	
19	,,	S S W	3	b q	29·94	73	
20	,,	W S W	6	m q	29·92	72	
21	,,	N N E	1	b c	30·04	69	
22	,,	N N W	7	q v r	30·04	64	

The weather from the 23rd to the end of the month of November, affords an example of hard blowing north-easterly winds, without veering; the thermometer low, and the barometer rising until past midnight: it then fell from that time until the 27th, when it began again to rise; and there may have been a gale passing on the east side of the Bermudas.

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Straight Line Wind.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Nov.23	Noon	N N E	6	p q r	30·16	61	
,,	Midnight	N N E	6	p q	30·29	60	
24	Noon	N N E	6	p q	30·18	64	
25	,,	N E by E	6	q	30·12	67	
26	,,	N N E	5	b c	29·98	69	
27	,,	N N E	7	p q	30·16	63	
28	,,	N E	6	b c	30·13	66	
29	,,	N E	5	q	30·06	67	
30	,,	N E by E	4	b c	30·07	68	

The month of December, 1839, presents a continual succession of revolving winds passing over the Bermudas, with scarcely an irregularity, as regards the fall and rise of the barometer accompanying the veering of the wind. One, however, occurred on the 10th and 11th. The S.W. wind abated, and changed to W. N.W., with the barometer still falling. But in the column of remarks it is noted, that there was lightning seen in the N. and N.W., from 7 P.M., during the night. This irregularity may, therefore, have been occasioned by a gale passing over the banks of Newfoundland, influencing the direction of the wind at Bermuda. On the 16th, the barometer, which had begun to rise, fell ·02 of an inch, and again it is noted in the register that there was lightning during the night in the N.W. On the 19th there is another irregularity, amounting to ·13 fall of the barometer. At the same time, the thermometer was falling, indicative of winds coming from cold regions at a considerable distance. These are fluctuations which might be explained, had we observations from a great distance all around. Similar fluctuations will be found in other parts of the register of the weather.

There was a storm at the Azores, as the following

extracts show, on the 5th of December, when the barometer at St. Michael's fell to 28·82 in., as recorded by Mr. Carew Hunt:—

"LISBON, Dec. 24.

"By a Portuguese schooner, which arrived from the Azores some days ago, accounts have been received of a dreadful hurricane at the Island of St. Michael, on the 5th instant. The sea rose upwards of thirty feet, and destroyed a great number of houses, including a part of the custom-house stores. The destruction of property is said to exceed 500,000 dollars. Fortunately only one life was lost, the inhabitants having made a timely escape to the mountains."

"BOADICEA TRANSPORT, DEPTFORD, Feb. 17, 1840.

"On our voyage home we experienced a severe gale on the 5th of December, commencing at 8 A.M., wind S.S.E and S., till 6 P.M., when it changed in hard squall to S.W. by S., which caused us to ship a heavy sea, and continued very severe till midnight, then W.S.W., blowing most violently until 4 A.M. of the 6th, when it abated. During the gale we lay-to under trysails, on the starboard-tack, which we found accord with the theory. Lat. 43°.12′, and Long. 25°.

(Signed) "RICHARD WARD."

Revolving Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Nov.30	Midnight	S S E	1	b c	30·06	65	
Dec. 1	Noon	S S W	3	b c	30·07	71	
2	,,	S W	5	g m q	29·86	70	
3	,,	S S W	3	g c	29·76	,,	
4	,,	S W	6	g m r	29·62	68	
5	,,	W N W	5	p q	29·56	,,	Squally.
6	,,	N W	6	p q	*29·55	,,	Squally.
7	,,	N N W	5	b c	29·78	70	
,,	Midnight	N N W	3	b c	29·89	68	
8	Noon	W N W	2	b c	29·82	71	
9	,,	S S W	5	p q	29·84	70	Lightning in N. and
10	,,	S W	2	b c	29·96	,,	N.W. from 7 P.M. during
11	,,	W N W	6	b c m	*29·88	68	the night.
12	,,	S S W	,,	b v	29·99	69	
13	,,	NW by N	,,	b v	30·01	66	
14	,,	N N W	5	b c v	30·06	64	
,,	Midnight	N W	2	b c p	30·05	63	

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Revolving Winds—*continued.*

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Dec. 15	Noon	S W by S	6	g m r	29·72	65	
,,	P.M. 2	S S W	7	m q r	29·92	64	
,,	,, 4	S S W	,,	g m q r	29·55	,,	
,,	,, 6	W S W	,,	q w	*29·53	,,	
,,	,, 8	N W	6	b c q	29·54	,,	
,,	,, 10	N N W	,,	b c	29·55	,,	
16	Noon	N W	7	b c m	29·53	62	Lightning in N.W. at
17	,,	N W by N	,,	p q	29·67	60	10 P.M.
18	,,	N W	6	c q	29·86	,,	
19	,,	N W by N	7	m q r	29·73	59	
20	,,	N N W	,,	p q	29·89	58	
21	,,	N W by N	6	c q[c]	29·96	56	

The surf which broke heavily on the western and north-western reefs on the 16th and 17th, broke on the northern reefs on the 18th, whilst the western reefs on the 18th showed much less surf. On the night of the 18th the wind backed towards west a little.

This heavy surf breaking on the Bermuda Islands first at the west end, is explained by the passage of the storm traced by Mr. Redfield, marked No. XVI. (See also the chart of the Atlantic, Chap. XIII.)

Revolving Winds—*continued.*

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1839.							
Dec. 21	Midnight	S W	1	b. c.	29·95	55	
22	Dawn	—	0				
,,	Noon	S S W	5	g m	29·83	56	
,,	P.M. 4	S	7	g m	29·79	,,	
,,	,, 6	S S E	,,	g m r	29·61	,,	
,,	,, 8	S S E	,,	w r	29·52	,,	
,,	,, 10	S E	,,	m w r	29·48	,,	
23	Noon	S W	6	b c m	*29·44	57	
24	,,	W N W	,,	b m	29·71	59	
25	,,	W N W	5	b c	29·88	56	
26	,,	N	3	c	30·09	62	
27	,,	S E	5	c q r	30·07	61	
28	,,	S W	6	c q	29·88	66	
,,	Midnight	S S W	,,	b c	29·76	65	
29	Noon	S W	7	c h	29·48	64	Lightning in N. W.
30	,,	W N W	6	b c q	29·83	55	from 7 to 10 P.M.
31	,,	N W	5	b c	30·12	58	

Remark printed in the Register.

"The changes of the wind during the December gales have been nearly the same in all, *i.e.*, commencing with a southerly wind at first, the wind has veered by the west, towards the north-west, sometimes ending as far round as north-north-west."

The same succession of revolving winds continued to pass over the Bermudas, but with rather more irregularity in the barometer, until the 11th of Jan. From the 11th to the 15th inclusive, both the changes of the wind and of the barometer exhibited much irregularity. At noon on the 15th, revolving winds began again, continuing to the 25th, when northerly straight-lined winds, with a high barometer, blew without veering for four days. On the afternoon of the 28th, veering winds again set in, when the barometer, which had risen very high, began gradually to fall. The descent of the barometer with small fluctuations, together with the veering of the wind, continued until noon of the 5th of February, when the wind from the S.E. had gone round by the S. and the W. to N.

On the 5th and 6th, the barometer rose to nearly half an inch above 30, and the wind blew fresh at N.E. On the 7th and 8th, the barometer began again to fall; and between the 8th and 12th, the wind completed another circuit.

Between the 13th and 22nd, the barometer stood high, with a longer interval than usual for the season, without the occurrence of revolving winds. On the 23rd the wind was east and nearly calm, and the sea breaking against the south side of the island. Then, again, began fresh revolutions, the wind blowing

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moderately and even lightly. These are amongst the many examples of moderate breezes revolving.

Revolving Wind.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	Remarks.
1840.							
Jan. 1	Noon	SW	5	c	29·96	59	
2	,,	NW	5	b c	29·64	64	
				Revolving Wind.			
3	Noon	ESE	3	c g	30·02	61	Wind veered from N. to E. to S. E.
4	,,	SW	5	b c	*29·99	62	
,,	Midnight	,,	4	c	30·13	59	
5	Noon	WSW	3	b c	30·14	,,	
6	,,	NW	4	g v	30·12	60	
7	,,	NW	4	c g r	30·02	58	Lightning in N. and N. W. during night.
				Revolving Wind.			
8	Noon	SW	5	b c q r	29·77	59	Wind very changeable during day and squally.
9	,,	NNW	7	c m q r	*29·92	57	Wind veered from S. W. to N.N.W. and squally.
10	,,	NW	4	c	30·07	58	
				Fluctuating Winds.			
11	Noon	SW	3	c g	30·14	59	
,,	Midnight	SSW	4	b c	30·15	57	
12	Noon	SSW	6	c h	30·02	58	
13	A.M. 6	NW	6	c h	30·02	58	
,,	,, 10	NNW	4	c h	30·02	58	
,,	Noon	N	3	b c h	29·97	60	
,,	P.M. 4	NW	2	b c h	29·97	60	
14	Noon	NW	4	c h	29·84	58	
15	A.M. 6	WNW	4	c h	29·84	58	
,,	,, 10	W	5	c h	29·84	58	
				Revolving Wind.			
15	Noon	WSW	6	b c	29·95	59	
16	,,	,,	6	c h	*29·91	58	
,,	P.M. 1	WNW	7	c h	29·91	58	Squally.
,,	,, 2	NW	7	c h	29·91	58	
,,	,, 3	NNW	7	c h	29·91	58	
				Revolving Winds.			
17	Noon	SW	1	c g	30·07	58	
18	,,	SW	2	c r	*29·94	59	
,,	Midnight	WSW	5	c g	29·95	57	
19	A.M 6	WNW	5				
,,	,, 6.30	NW	6				

Probably Straight Line Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	Remarks.
1840.							
Jan. 19	A.M. 7	N	7				
,,	,, 8	NNE	7				
,,	Noon	NNE	7	c h r	30·07	57	Squally.
20	,,	NW	3	c g	30·24	59	Wind backed from N.N.E. to N.W.

Light Revolving Wind.

21	Noon	SW	4	b c	30·21	60	
22	,,	SW	3	b c	30·19	60	
23	,,	S	6	c h	*30·08	59	
24	,,	SW	2	g h	30·09	58	
,,	P.M. 1	WSW	2				
,,	,, 2	W	2				
,,	,, 3	WNW	2				
,,	,, 3.30	NNW	3	h			
,,	,, 4	N	4				

Straight Line Wind with High Barometer.

25	A.M. 10	NNE	4	g h	30·27	58	
,,	Noon	NNE	4	g h r	30·28	38	
,,	P.M. 3	NE	4				
,,	Midnight	N	4	g q r	30·25	56	Squally.
26	Noon	N	5	b c	30·24	58	
27	,,	NE	3	b c	30·32	60	
28	,,	E	5	b c	30·34	60	

Revolving Wind.

28	P.M. 2	ESE					
,,	,, 4	SE					
29	Noon	SSE	6	b	30·31	61	
30	,,	S	5	h	30·22	60	
31	,,	SSW	6	h	30·31	61	
Feb. 1	,,	SSW	6	c h	30·25	60	
,,	Midnight	SSW	5	c h	30·21	57	
2	Noon	SSW	4	c h	30·24	60	
3	A.M. 10	SW					
,,	,, 10.30	W					
,,	,, 11	WNW					
,,	Noon	NNW	6	g h	30·21	59	
4	,,	NW	5	b c	29·87	56	
5	A.M. 10	NNW					Surf beating high on
,,	Noon	N	6	b c	30·23	55	northern reefs.

Easterly Wind with High Barometer.

5	Noon	NE.	5	b c	30·46	57	
,,	P.M. 4	ENE					
6	Noon	NE	5	b c	30·46	57	
7	,,	ESE	4	b c	30·42	59	
8	,,	SE	3	b c	30·34	60	
,,	Midnight	E	3	b c	30·31	58	

Revolving Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	Remarks.
1840.							
Feb. 9	Noon	ESE	2	b c	30·21	61	
10	,,	S	4	b c	30·08	61	
11	,,	SSW	6	c h	*29·88	61	
12	A.M. 6	W					
,,	,, 6.30	WNW					
,,	Noon	NW					
,,	P.M. 4	NNW					
,,	,, 6.30	N					

Straight Lined Easterly Winds and High Barometer.

13	Noon	NNE	5	b c	30·22	59	*Remark in the Register.*
14	A.M. 6	NE					The winds which blew
,,	Noon	ENE	5	b c	30·39	60	during the last week at
15	,,	NE	1	b c	30·28	61	Bermuda, are those which
,,	P.M. 6	NE	5	..	30·28		rather raise than depress
,,	Midnight	NNE	2	b c	30·24	58	the barometer. They are
16	Noon	NE by N	5	b c	30·24	61	supposed to be different
17	,,	NE	5	c	30·32	62	from those revolving winds,
18	,,	E	4	b c	30·33	62	which cause that instrument
19	,,	ESE	4	b c	30·38	62	greatly to fall below its
20	,,	ESE	4	b c	30·41	63	ordinary level.
21	,,	SE	3	c h	30·39	64	
22	,,	ESE	3	b c	30·39	65	
,,	Midnight	ESE	2	c	30·34	59	

Light Revolving Wind.

23	A.M. 6	E	1	..	..	..	Sea roaring in S. E.
,,	Noon	ESE	2	b c	30·26	65	Wind veering.
24	A.M. 6	SE	2				
,,	Noon	S	3	c h	30·09	66	
25	A.M. 6	WSW	3				
,,	,, 9	WSW	4				
,,	Noon	NW	4	c h	*29·93	64	
,,	P.M. 3.30	N	5				

Interval of Easterly Wind and High Barometer.

25	P.M. 8	NE	5				
26	Noon	ENE	3	b c	30·24	64	Wind veering.
,,	P.M. 6	E	3				

Revolving Wind.

27	A.M. 6	SE	1				
,,	Noon	S	1	b c	30·25	65	Wind veering.
28	A.M. 6	SSW	1				
,,	Noon	NW by W	1	b c	30·23	65	
29	,,	NW	3	b h	*30·06	65	
,,	Midnight	N	3	c h	30·09	60	

Interval of North-Easterly Wind.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	Remarks.
1840.							
Mar. 1	Noon	N N E	4	b c	30·09	65	
,,	P.M. 6	N E					
,,	,, 8	E					
2	A.M. 6	S S E					
,,	Noon	S	4	b c	30·14	66	
,,	P.M. 4	S W					
3	Noon	W S W	2	b	30·17	68	
4	,,	W S W	4	b g	30·03	68	
5	,,	S W by W	5	g h	29·56	68	
,,	P.M. 5	W	6				
6	A.M. 5.30	W N W	6				
,,	Noon	N W	6	b c	29·83	62	

On the 7th and 8th of March the wind was fluctuating. Distant thunder is recorded in the register.

On the 9th a new circuit of the wind had set in, followed by another on the 12th, with an interval of a few hours of light wind between.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1840.							
Mar. 7	A.M. 6	W N W	5				
,,	Noon	W	6	g h	29·84	64	
,,	Midnight	N W	4	m h	29·81	60	
8	A.M. 6	W	...	...	...	..	Distant thunder in N.W.
,,	,, 9	N W					
,,	,, 11	N					
,,	Noon	N N E	5	g h	29·85	65	
,,	P.M. 6	N E					
,,	,, 8	E					
		Revolving Wind.					
9	A.M. 5	S E	..	...	29·85		
,,	,, 6	S					
,,	,, 9	S S W					
,,	Noon	S W	4	q h	*29·81	65	Thunder and lightning.
10	,,	W S W	5	h	29·89	68	
11	,,	W S W	6	h	29·77	68	Distant thunder in S.W.
,,	P.M. 2	W					at 8.45 A.M.
,,	,, 9	N W					
12	Noon	N	1	c h	22·83	08	

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Short interval of Light Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1840.							
Mar.12	P.M. 1	NNW	1				
,,	,, 2	W					
,,	,, 2.15	SW					
,,	,, 2.30	S					
,,	,, 3	SSE	1				
,,	,, 7	S					
,,	,, 9	SW					
13	A.M. 6	WSW					
,,	Noon	W	7	h	29·81	65	
,,	P.M. 5	NW					
14	Noon	NW by N	7	c h	30·11	56	
,,	Midnight	NW by N	5	b c	30·14	52	
15	Noon	NW	5	c d	30·16	64	
,,	P.M. 2	WNW	4				
,,	,, 3	W	4				
		Revolving Wind.					
16	Noon	WSW	5	g h	30·02	65	
17	,,	SW by W	6	c h	*29·98	66	
18	A.M. 6	W	4				
,,	Noon	WNW	3	c h	30·07	68	
,,	P.M. 3	NW	3				
		Light Wind.					
18	P.M. 9	W	2				
19	A.M. 5	SW	2				
,,	,, 5.30	S	3	...	...	..	Distant thunder in S.W. and N.W. from 3 to 7 A.M.
,,	,, 10	SW	4				
,,	Noon	WSW	5	c h	30·07	68	
20	,,	W	4	g h	*29·93	68	Distant thunder in the west at 3 P.M.
,,	P.M. 8	WNW	3				
21	A.M. 5	NW	4				

The next recorded observations show the barometer rising, and the wind nearly steady until the evening of the 23rd, when another circuit commenced.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1840.							
Mar.21	A.M. 7	N	5				
,,	,, 10	NNE	5				
,,	,, 11	NE	5				
,,	Noon	ENE	5	g h	29·88	66	
,,	Midnight	NE	2	c h	29·99	60	
22	A.M. 5	N	2	c h	29·88	59	
,,	,, 6	NNW	3	g h	29·91	60	
,,	Noon	N	6	c h	29·92	65	
23	,,	NNE	4	b c	30·18	60	
,,	P.M. 5	NE	1	b c	30·19	59	

Revolving Wind.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1840.							
Mar. 23	P.M. 5.30	E	2	b	30·18	58	
,,	,, 9	ESE	1	c	30·15	56	
24	A.M. 5	SSE	3	c g	30·09	59	
,,	,, 6	S	4	c h	30·05	60	
,,	,, 10	....	5	b c	30·02	63	
,,	Noon	SSW	6	b	29·95	64	
,,	P.M. 9	....	5	c h	29·88	59	
25	A.M. 5	....	6	c h	29·71	58	
,,	,, 8	....	6	c h	29·68	66	
,,	Noon	SSW	6	c h	29·66	68	
,,	P.M. 9	....	5	g h	29·58	59	
26	A.M. 5	WSW	7	c h	*29·47	60	Thunder and lightning
,,	Noon	W	7	b h	29·54	67	in the west from 3 to 4.30
,,	P.M. 4	WNW	6	c h	29·68	65	A.M.
,,	,, 6	NW	6	c h	29·81	60	
,,	,, 10	N	5	c h	29·92	57	

Interval of Steady Wind with the Barometer High.

27	A.M. 9	NNE	4	b c	30·18	63	
,,	Noon	NE	5	c h	30·25	62	
28	,,	ENE	5	b c	30·33	64	
,,	Midnight	E	4	b	30·27	58	

Revolving Wind.

29	Noon	E	5	c h	30·24	67	
30	A.M. 5	ESE	2	c h	30·12	60	
,,	Noon	SSE	4	c h	30·09	70	
31	A.M. 6	S	3	c h	30·08	59	
,,	Noon	SSW	3	c h	*30·06	66	
April 1	A.M. 9	W	4	c h	30·07	66	
,,	,, 10	WNW	3	g h	30·09	66	
,,	,, 10·30	NW	5	g h	30·11	67	
,,	,, 11	N	5	g h	30·12	67	

Interval of Fluctuating Winds.

1	Noon	NNE	5	g h	30·13	67	
,,	P.M. 9	N	3	b c	30·14	58	
2	A.M. 5	NW	3	b c	30·15	57	
,,	Noon	NNW	4	b c	30·14	66	
,,	P.M. 9	N	3	b c	30·11	59	
3	A.M. 11	NE	4	c	30·21	64	

Revolving Wind.

3	Noon	E	3	g	30·22	64	
,,	P.M. 9	ESE	2	c	30·18	58	
4	,, 5	S	6	g h	30·06	58	
,,	Noon	SW	5	b c	30·05	66	
,,	Midnight	W	4	b	30·03	59	
5	Noon	W	4	b c	*30·03	68	
,,	P.M. 4	NW	4	c h	30·04	68	Distant thunder from 3
,,	,, 5	NW	1	b	30·04	67	to 5 P.M. in N.W.

Interval of Light Fluctuating Wind.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1840.							
Apr. 5	P.M. 5.50	W	1	c	30·04	60	
,,	,, 8	S	1	b c	30·06	00	
,,	,, 10	E S E	2	b c	30·07	58	

Revolving Wind.

6	A.M. 10.30	E	3	b c	30·14	66	
,,	Noon	E S E	2	b c	30·15	67	
7	,,	S S W	5	b	30·08	02	
,,	P.M. 10	W	6	c g	*29·95	64	
8	A.M. 4	N	7	c h	29·95	58	

Light Summer Winds now setting in with little movement of the Barometer.

8	Noon	N N E	6	b c	29·99	64	
9	,,	N E by N	6	c	30·17	62	
10	,,	E	6	c h	30·32	67	
11	,,	E S E	6	c h	30·31	67	
,,	Midnight	E S E	4	c h	30·29	59	
12	Noon	S S E	5	b	30·29	68	
13	,,	S	2	b c	30·17	72	
14	A.M. 4	W	3	h	30·13	59	
,,	,, 8	N	2	b c	30·09	66	
,,	Noon	N W by W	2	g c	30·08	70	
15	,,	N N E	3	b c	30·09	69	
16	,,	W N W	3	c g	30·02	67	
,,	P.M. 3	N	1	c g	*30·01	66	
,,	,, 4	E	1	c g	*30·01	66	Sea roaring E.S.E.
17	Noon	N N E	2	b c	30·05	67	
18	,,	E by S	2	b c	30·17	72	
,,	Midnight	S S E	1	b c	30·18	60	
19	Noon	S S W	2	b c	30·19	73	
20	,,	W S W	5	b c	30·19	73	
21	,,	W N W	1	c g	30·17	70	
,,	P.M. 2	N	3	c g	30·17	70	
,,	,, 4	N by E	6	c g	30·17	68	
22	Noon	E by S	5	b c	30·21	66	
23	,,	S E by S	5	c h	30·18	72	
24	,,	S	4	g h	30·18	74	
25	A.M. 11	W	1	c h	30·25	73	
,,	Noon	N	1	g h	30·25	74	

Light Fluctuating Winds.

25	Midnight	W	1	c h	30·27	67	Sea roaring S. side from
26	Noon	S W	2	c h	30·28	76	6 P.M. to midnight.
27	,,	S W by S	4	b c	30·25	75	
28	A.M. 4	W	2	b	30·33	67	
,,	,, 10	N	4	b c	30·37	72	
,,	Noon	E	5	b	30·38	75	

Revolving Winds.

Date.	Hour.	Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	General Remarks.
1840.							
Apr. 29	Noon	E S E	4	c h	30·41	73	
30	,,	S W by S	5	b	30·23	76	
May 1	,,	W S W	5	c h	30·09	76	
2	,,	W S W	6	c h	*29·97	75	
,,	P.M. 6	W	5	c	*29·97	70	
,,	Midnight	N	3	c h	29.99	68	
3	Noon	S S E	2	b c	30·07	76	
4	,,	S W	5	c h	29·93	76	
5	,,	W	5	c h	*29·72	75	
6	,,	N W by W	5	b c	29·74	71	
7	,,	N W by W	5	b c	29·87	70	
8	,,	N W by W	5	b c	29·97	70	
		Short interval of Light Wind.					
9	A.M. 4	W	3	c g	29·99	67	
		Revolving Wind.					
9	Noon	S W by S	5	c h	29·94	76	
,,	Midnight	S W by S	6	c h	29·76	65	
10	Noon	S W by S	6	c h	*29·72	76	Thunder and lightning
11	A.M. 4	W	5	c g	29·87	69	from 11 A.M. to 9 P.M.
,,	Noon	N W	2	c b	29·99	73	
		Interval of North and East Winds.					
12	Noon	N	2	b c	22·94	75	Sea breaking high E. of N.
13	,,	N N E	4	b c	30·07	73	rock; lightning in N.W.
14	,,	E	4	b c	30·18	73	Lightning in the W. at
15	,,	E	4	b c	30·15	72	10 P.M.
16	,,	N	3	b c	30·19	74	
,,	Midnight	N	2	b c	30·25	62	
17	Noon	N	3	b c	30·28	74	
		Revolving Wind.					
18	Noon	E	2	b c	30·26	72	
19	,,	S	3	b c	30·19	75	
20	,,	S	3	b c	30·14	75	
21	,,	S S W	6	g g	29·94	73	
22	A.M. 10	W	3	c h	*29·91	74	
,,	Noon	N W by W	3	b c	*29·91	76	Lightning in the N. at
23	,,	N	5	b c	30·08	75	at 9 P.M.

A very interesting mode of testing the Law of Storms, is that of considering the probable line of progession and extent of gales in their passage. It was thus that I was in the habit of studying the winds

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at Bermuda for nearly eight years, and that Mr. Redfield has studied them at New York for a much longer period. In 1839, Mr. Redfield wrote to me from New York, when he first heard of the September gale of that year, that he thought it must have passed over Bermuda; and this was before he could have heard from those islands. A reference to the plate facing page 39, will show how correct his judgment was, for the centre touched the westernmost part of the islands.

At Bermuda the supposed track and extent of that storm was laid down on a chart of the Atlantic; and as many of the inhabitants had relatives at sea, the progression and extent of it were earnestly considered. A vessel, called the Queen Victoria, full of passengers, had sailed for New York two days before the gale reached Bermuda. Her course and distance were more than once laid down on the chart, and we felt satisfied by anticipation that, although within circuit of the storm, she would be beyond danger. Her place will be found on the chart facing page 39. The storm passed over her very nearly in the manner expected, and she was hove-to for six hours.

The track on the marine chart above alluded to, was amended as additional information gradually came in; and it is that chart as revised which is here engraved on a reduced scale.

Another striking instance of this method of judging of the truth of the theory of storms, happened in October, 1845. Mr. Redfield, at New York, wrote to me at Bermuda, that he much feared the mail-packet would encounter, on her passage to Bermuda from Halifax, one or other of two gales, which had just then passed

the meridian of New York. The one on the 19th, the other on the 22nd; and he added, that the gales had followed a more easterly course than usual.

Along with Captain Barnett, R.N. (commanding H. M. surveying ship Thunder) I had myself observed the passage of the gale alluded to of the 22nd of October, on the morning of the 24th, as it crossed the meridian of Bermuda. Captain Barnett was about to dismantle a temporary observatory, and delayed doing so from observing a fall in the barometer. The wind continuing to veer by the west towards the north, it was evident that the observed gale had passed the meridian we were upon. At sunset the Halifax mail-boat came in sight. She had fallen into the western-most side of the gale, in which the wind blows northerly, and in consequence had made a rapid passage. This no doubt was the gale which Mr. Redfield had observed passing the meridian of New York on the 22nd, and expected the mail-boat to fall into.

This gale was closely followed by another, which passed on the east side of the Bermudas on the 27th of October. An extract from the weather table will be found in the next page.

Meteorological Report, kept at the Central Signal Station, Prospect (134 feet above the level of the sea), showing the fluctuations of the Barometer.

		Direction of Wind.	Wind's Force.	Weather.	Bar.	Ther.	Remarks.
		S E	1	c p	30·03	74	
		E N E	4	b c	29·99	74	
		N W	3	b c	29·83	75	
		N W by W	5	b c p	29·81	76	
		N W	6	c p q u	29·80	76	
		N N W	6	c q	29·86	74	
	6	N N W	6	b c q	29·92	74	
	9	N	6	b c q	30·00	74	
	Noon	N by E	6	b c	30·06	75	
6	9	N E	5	o p q	30·19	72	
	Noon	E	5	o q r	30·16	73	
	P.M. 9	E	7	q r	30·03	71	
27	A.M. 2	S E	8	c u	29·90	,,	
	,, 6	,,	1	o d	29·81	72	
	,, 8	N E	6	c h u	29·79	,,	
	,, 9	,,	8	h p q	29·75	73	
	A.M. 10.30	N N E	9	d q	29·73	,,	Wind increasing.
	,, 11	,,	,,	h q	29·73	,,	
	Noon	N by E	,,	d d q	29·71	72	Wind still increasing, every
	P.M. 3	N	10	h p q	29·75	73	appearance of a gale.
	,, 7	N by E	9	,,	29·78	72	
	,, 9	N	8	c q	29·83	71	
28	A.M. 9	N by W	8	c q	29·92	70	
	Noon	N N W	7	b c p q	29·98	,,	
	P.M. 9	N by E	5	b c	30·00	,,	
29	A.M. 8.30	N by W	4	c h	30·03	60	
30	,, 9	N N E	4	b c h	30·04	70	
	Noon	,,	3	b c	,,	73	
31	A.M. 9	N	4	b h	30·13	70	
Nov. 1	,, 9	E		b h	30·16	72	Calm.

Notes in the Register.

"On the 27*th* of *October* a whole gale from about 1.45 P.M. to 3.45 P.M. with sudden gusts of wind.

"The way in which the wind veered on the 27th and 28th indicates a storm passing by on the eastward side of the Bermudas."

Useful practical deductions may be drawn from the above weather tables; and they serve to show the application of the rules laid down in a "note on the winds as influencing the tracks sailed by Bermuda vessels," published in the second edition of the Law of

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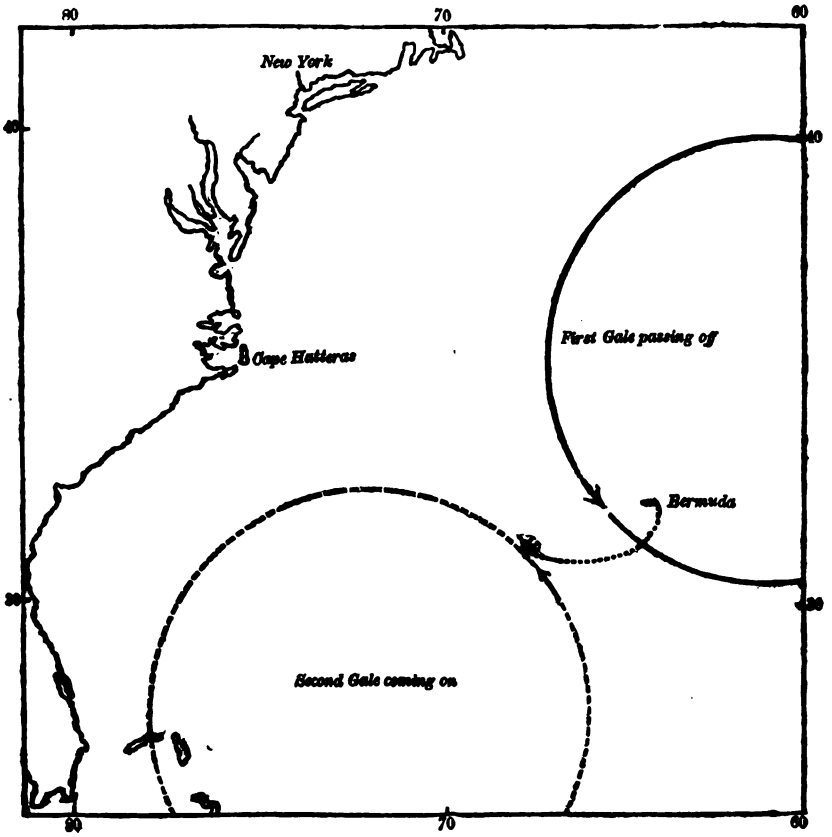
Storms, and now embodied in the fifteenth edition of Blunt's American Coast Pilot. CHAP. X.

Sailing from Bermuda to NewYork.

The first half of a revolving gale is a fair wind from Bermuda to New York, because in it the wind blows from the *east;* but the last half is a fair wind from New York to Bermuda. During the winter season, most of the gales which pass along the coast of North America being revolving gales, vessels from Bermuda bound to New York, should put to sea when the *north-west* wind, which is the conclusion of a passing gale, is becoming moderate, and the barometer is rising to its



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usual level. The probability will be, more particularly in the winter season, that, after a short calm, the next succeeding wind will be *easterly*, the first part of a fresh revolving wind coming up from the south-west quarter.

A ship at Bermuda, bound to New York or the Chesapeake, might sail whilst the wind is still *west* and blowing hard, provided the barometer indicate that this west wind is owing to a revolving gale which will veer to *northward*. But as the usual track which gales follow in this hemisphere is northerly or north-easterly, such a ship should be steered to the southward. As the wind at *west*, veers towards *north-west* and *north*, the vessel would come up and at last make a course to the westward, ready to take advantage of the *east* wind, at the setting in of the next revolving gale.

See fig. page 267.

Sailing from New York to Bermuda.

A vessel at New York and bound to Bermuda, at the time when a revolving wind is passing along the North American coast, should not wait in port for the westerly wind, but sail as soon as the first portion of the gale has passed by, and the N.E. wind is veering towards *north*, provided it should not blow too hard. For the *north* wind will veer to the *westward*, and become every hour fairer for the voyage to Bermuda.

Sailing between Bermuda and the West Indies.

Ships intending to sail from Bermuda to the West Indies, or to the southward, may do so with advantage in the middle of a revolving gale, and as the wind is veering to the west; for if it has been south-west, veering to west, commanders may calculate on its becoming northerly, which might carry them to the Trades. If intending to go to the most windward of the West India Islands, they should make a *curved course*, steering at first well to the eastward of south,

so as to be to windward of the islands when they enter the Trades. As the Bermuda gales have a northerly progression, the wind may be expected to moderate to ships sailing southerly.

H. M. ship Endymion.

Calculating on the veering of the wind on this principle, Captain Lambert, Commander of H. M. ship Endymion, sailed from Bermuda for Barbados on the 20th of April, 1846, and made the voyage, as shown in the following extract from the Endymion's log.

Extract from the Log-Book of H. M. Ship ENDYMION.

Date. 1846.	K.	Courses.	Wind.	Force.	Weather.	Bar.	Ther.	Latitude & Longitude, and Remarks.
Apr. 19								
P.M. 1	..	At anchor,	E S E	3	b c	...	..	Arrived Royal Mail
6	..	Bermuda.	S Easterly	4	c	...	..	Steamer Forth.
12	..	.....	Southerly	3	b c	...	..	Sunset, up boats.
Apr. 20								
A.M. 1	..	.....	.....	3	c	...	..	A.M. Employed getting in boats, and preparing for sea.
5	..	.....	S Westerly					
9	..	.....	N Westerly	4	b e p			P.M. Employed unmooring ship. 1.30, made sail to second-reefed topsail, courses, and second-reefed driver and jib. Slipped the moorings, tacked, made, and shortened sail, as required; working for St. George's. 2.50, split the jib in a squall; found blown away canvas 51 yards. Shifted ditto. 4, passed through the narrows; discharged pilot 4. 10, bore up, St. David's Head S. one mile. 5, Set topgallant sails. 6.45, mustered at quarters.
		Working for St. George's.						
P.M. 5	8	S E	Northerly	6	b c o p			
6	7·6	.....	N N E					
10	9·5	.....	North.	5	b c g			
Apr. 21								
A.M. 1	9·5	S E	North.	4	g	...	..	A.M. 1.45, in fore and main-topgallant sails, and lee clue of mainsail. 2, lower the top-
2	10	.....	N W	8	c a r l			
3	9·5	.....	Northerly	6				
6	9	.....	.....	7				

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Extract from the Log-Book of H. M. Ship ENDYMION—*continued.*

Date. 1846.	K.	Courses.	Wind.	Force.	Weather.	Bar.	Ther.	Latitude & Longitude, and Remarks.
Apr. 21								
A.M. 9	9	.....	.....	1	c a p			sails to a heavy squall
12	9·6	.....	.....	..	b c d	29·87	67½	from N.W. 5.30, in third reefs, in topsails. 6, hoisted topsails. 8.15, set in topgallant-sail. Noon, altered course to S.E. by S.

Course.	Distance.	Latitude.		Longitude.		Bearing and Distance.
		D.R.	O.	D.R.	CHRON.	
S 49° E	183′	30. 22	30. 27	61.°54′	62°. 4′	N.E. point Barbados. S. 7°.30′, E. 10°.45′.

Apr. 21								
P.M. 1	9·6	S E by E	Northerly	5	b c q	...	..	P.M. 1, altered course
2	10	S S E						to S.S.E. Trimmed
3	8	.....	N N W					in main-topgallant-sail. 6, set main-top-gallant-sail. Mid-night.
12	9							
Apr. 22								
A.M. 1	10	S S E	N E	6	b c	...	..	A.M. 1, trimmed,
4	9	.....	.....	5	b c p			hauled aft main sheet.
6	8·4	.....	N N E	..	b			7.30, out second reefs
10	10·2	.....	.....	..	....	30·01	69	of topsails, and set top-gallant-sails. 11.45, set port-studding-sails.

Course.	Distance.	Latitude.	Long. Chron.	
S 25° E	221′	Obs. 27°. 7′	60°. 11′	

Apr. 22								
P.M. 2	9	S S E	N Easterly	5	b c			
12	8	.....	.....	5				
Apr. 23								
A.M. 6	7	S S E	N N E	4	....	30·10	70	Lat. 24°.24′, Long.
P.M. 1	7	S S E	N Easterly	4				59°.2′.
Apr. 24								
A.M. 1	8·6	S S E	N Easterly	5				
5	7·6	.....	East		....	30·09	75	Lat. 21°.20′, Long.
8	7·4	S by E	E by S					57°.53′.
P.M.	7	S by E	E by S	3	b c			
12	9							
Apr. 25								
A.M. 1	8·5	S by E	E by S	4	b c			

Extract from the Log-Book of H. M. Ship ENDYMION—*concluded.*

Date. 1846.	K.	Courses.	Wind.	Force.	Weather.	Bar.	Ther.	Latitude & Longitude, and Remarks.
Apr. 25								
A.M. 12	9·5	South	.....	..	....	29·99	78	Lat. 17°.29′, Long. 57°.30′.
P.M. 2	8·5	S by W	E by S	4	b c			
12	8·5							
Apr. 26								
A.M. 1	9	S by W	E by S	4	c			
12	4	S W by W ½ W	.....	..	c q p	29·98	81	Lat. 14°.54′, Long. 58°.37′.
P.M. 1	5	S S W	E by S	4				
12	7·4	South	.....	4	b c q			
Apr. 27								
A.M. 1	7	South	E by S	4	....	30·01	84	A.M. 3.3, up main-sail, in top-gallant-sails. 4.30, bore up W.S.W. 6.15, land on lee bow. 10.30, anchored in Carlisle Bay, Barbados.

Vessels returning from the most windward of the West India Islands in the winter season, when westerly winds are most prevalent, should take advantage of the trade-wind, and sail in a *curved course*, somewhat to the westward. When they sail on a direct course, they sometimes fall to the eastward, and find it very difficult to make Bermuda when westerly winds prevail.

Currents.

There is reason for thinking, that the currents of the sea amongst the West India Islands are much influenced by the winds which blow between Bermuda and Cape Hatteras. Winds which accelerate the current of the Gulf of Florida stream, may be expected also to accelerate the currents which generally run strong between Grenada and St. Vincent, as well as between the other Antilles Islands. But when long-continued north-east winds blow over Bermuda and the Gulf stream, that stream is checked. The tides amongst the West India Islands then rise higher than

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usual, as I found from tidal observations, sent to me by Major Lang from Santa Cruz; and probably this may be the reason why the currents usually found running between the West India Islands are not always regular, and sometimes set to the northward, past Barbados.

Choosing anchorages.

It has been stated by Captain King, and observed by other navigators of high latitudes in the southern hemisphere, "that bad weather *never comes on suddenly from the eastward;* neither does a *south-west or southerly* gale shift suddenly to the *northward.* South-west and southerly winds rise suddenly and violently, and must be well considered in choosing anchorages, and preparing for shifts of wind at sea."

The first part of the above remark applies equally to the northern hemisphere. East winds seldom come on suddenly in either hemisphere; but the latter part of the remark requires to be reversed for the northern hemisphere. North of the Equator, *north-west or northerly* gales do not shift suddenly to the *southward,* excepting within the Tropics, or when the gales may be moving with a westerly progression. North-west and northerly winds, of high latitudes, in the northern hemisphere, rise suddenly and violently, owing to the progression of these gales being easterly, and their revolution opposite to that of gales south of the Equator. This difference should be considered when *choosing anchorages, or preparing for shifts of wind at sea in north latitude;* and the following may serve as an example.

Ships intending to enter the harbours of the Bermudas by the main channel, cannot do so with the wind at north-west. They are kept under weigh until

the wind changes, and in the winter season, sometimes at the expense of their rigging: but when a northerly or north-west gale, with a rising barometer, has quickly followed a southerly gale and falling barometer, ships may be anchored with confidence on the south side of the main Bermuda island, in places known to the pilots, until the northerly gale moderates. They should then weigh anchor and stand to the eastward, for the entrance of the main channel, and not remain longer at anchor on the south side of the island, because the next gale which follows may be expected to set in at east or south-east.

It may be sufficient under ordinary circumstances, at stations on land, where the state of the weather is observed, to record the observations at fixed hours of the day; but when gales are passing over, all changes of wind and of atmospheric pressure should be noted. The tables published in this chapter, and more particularly the observations recorded at Dodabetta, printed at page 161, will show the value of making and recording many observations when storms are passing.

CHAPTER XI.

GALES AT MADEIRA AND IN THE MEDITERRANEAN.

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VERY little information on the subject of revolving winds on the borders of the tropics has been obtained for the eastern side of the Atlantic. In a description of the Madeira Islands, by Captain Vidal, R.N., published in the Nautical Magazine, the account he gives of the winds, shows that there is a great resemblance between the weather there and at the Bermuda Islands, which lie in the same latitude.

Captain Vidal says, "So far as we could learn from inquiry, no gales occur here from the middle of April to near the close of September. They are principally to be apprehended in November and December, commencing a few points on either side of south, then gradually veering round to the westward and terminating in the northwest. . . Towards the middle of October periodical rains may be expected, and to continue generally about fourteen days. They frequently commence with *strong south-east winds, which veer to the south-west, and round to the north-west*, when it clears up and becomes fine. Saint Martin's summer succeeds to these, and extends usually over the same period of time, accompanied with north-east winds. There is, however, much irregularity about this Saint Martin's summer, for it is sometimes delayed to December.

"The north-east trade wind sets in about the middle of April and continues until the end of September.

"In March the winds generally prevail from the north-west, and at times blow very hard."

It is much to be desired, that observations on the the weather throughout the year should be made and published at Madeira, as is done at Bermuda. English residents there, when they know the increasing interest taken in these investigations, and their importance to navigation, will no doubt track the storms which pass over the island.

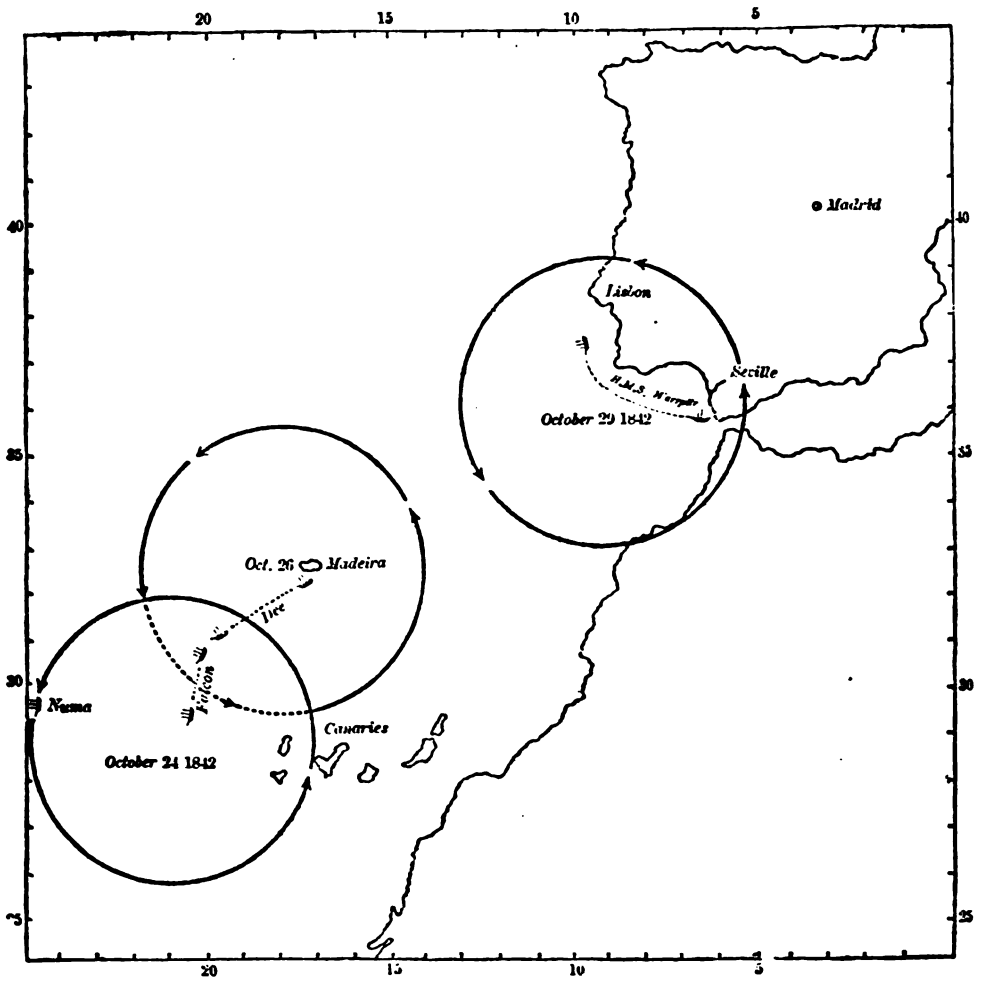
I am enabled to give one interesting example here of the track of a storm, which deluged Madeira with rain, in October, 1842, and wrecked several vessels in Funchal Roads.

Madeira Storm of October, 1842.

At Madeira, in 1842, rain set in on the 13th of October, and some days later it fell as a deluge, proving very destructive to the island. Six vessels were at anchor in Funchal Roads on the 26th, when the gale represented in the annexed diagram set in.

It seems probable that this storm came from the African continent, and was recurving whilst passing over the Canary Islands; for the Numa transport, a little to the southward of Lat. 30°, had the wind falling light at 8 P.M. on the 24th October, after which it rose at *north*, increasing in strength, so as to be called in the log-book, a hurricane. With the Numa the wind veered north-westerly.

On the 24th of October, the Falcon brigantine, from



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Madeira, bound to Demerara, was in Lat. 31°.10′ N, Long. 19°.45′ W. This vessel had the wind first S.E., veering by the E. to N.E., becoming N. and N.W. In her log-book, the storm is called a hurricane, and she was hove over, and nearly lost.

The Dee, W. I. mail steamer, on the 25th, with difficulty landed her Madeira passengers, owing to the

swell of the sea at Funchal, but could not land the baggage for the heavy surf. At 11.40 A.M. the Dee "set a-head full speed," and at noon the log-book records, "weather very fine and clear, set all sail;" but by midnight the Dee was in the heart of this gale.

Extract from the Log of the C. Steam Vessel DEE.

Courses.	Wind.	Remarks.
		October 25th.—*Civil Time.*
	S by E	A.M. Squally, with rain and much lightning. At 4, set
	S W by S	a-head, head N.N.E., very heavy rain, wind variable. 7.30,
		hove-to in Funchal Bay, fired a gun, and hoisted a whift
	Variable	for boats. At 8, boats came alongside for luggage, loaded
		all of them. At 9, Admiralty Agent returned on board. 11,
		loaded pinnace with luggage and put it on board the brig
		"Dart," of London, lying at anchor, there being too much
W by S	N E	surf to land it. 11.40, set a-head full speed. *Noon, very fine*
		and clear weather, set all sail.
	Southerly	P.M. Employed clearing decks and loosing sails to dry.
		At 4, N.W. end of Madeira N.E. by N. At 5.30, furled
		squaresails. Bar. 29·95; weather looking bad. At 7, dark
	S S W to	and cloudy, heavy rain with much thunder and lightning.
	S E and	At 8, strong breezes with hard squalls; rain and lightning,
	N E	with thunder; a heavy cross sea. Bar. 29·69. Midnight,
	S W by S	weather getting worse.
		October 26th.
W by S	S by E	A.M. Tremendous gales, very heavy rain, a heavy cross
West		sea, the ship rolling deeply. At 4, set trysails and fore stay-
		sail. 6.30, sudden shift of wind, an exceeding heavy squall
S W	N N E	to N. E. carried away the clue of main-trysail, and took in
W S W		the others; secured the anchors on the gunwale. 8, set fore-
N W		staysail, very heavy sea running. Bar. 28·50. 9.15, brought
W by S ½ S	N E	the ship up to N. W., squalls very heavy, down fore stay-
		sail. 10, Bar. 29·10; more moderate, bore-up. 11, set fore-
		trysail close-reefed, bent storm trysail in lieu of the one car-
	N by W	ried away. Noon, weather looking better. No observation.
W by S ½ S		Lat. by Account 31°. 1′ N., Long. Account 19°. 46′ W.
	N N W	P.M. 1, set storm main-trysail. 3, more moderate,
W S W		weather breaking, strong breezes and passing squalls;
		occasional light showers. Midnight, fine weather. Bar.
W by S ½ S		29·80.

"W. T. BELLANS, Lieut. R.N.,
"Admiralty Agent.

"Memorandum.—The Dee arrived at Antigua on the 7th November, and never had a trade wind the whole voyage, only variable winds.

"W. T. B."

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In Lloyd's List the wind at Madeira is stated to have veered from *south-east* to *south*, and *south-west*, on the 26th. A newspaper account says, that the vessels at anchor were observed to be rolling alternately both gunwales under water; and it concludes by stating, that "the Success alone was saved. She broke her chain, and all hope was given up, but just at that moment the *wind veered to the west*, and enabled her to change her ground to advantage, and the storm subsided next morning."

I suppose this to have been the same storm which passed along the south of Spain, blowing down some houses in Seville, on the 29th of October, and uprooting trees in the public walks. Several vessels off Cadiz were severely damaged by it; and H.M. ship Warspite, commanded by Lord John Hay, near Cape St. Vincent, was within its influence.

The following is an extract from the log-book of that ship:

"On the forenoon of the 28th the Warspite had light winds southerly and variable, when the Bar. began to descend.

H.M. ship Warspite.

H.	K.	Courses.	Wind.	Force.	Weather.	Bar.	Ther.	Latitude and Longitude, and Remarks.
A.M.								October 28th.
3	·2	S E by E	Southerly	2	b c	29·82	68	Lat. 37°.4′.
6	3	S W by W	Variable					Long. 9°.22′.
12	3·4	W S W		3	o c	29·80	68	7 P.M. in top-gallant-sails.
P.M.								7.45, in 2nd reefs fore and
3	4	W by S	Southerly	3	c	29·65	70	mizen-topsails.
7	5	W by S ½ S		4	c g	29·60	68	8.30, in 2nd reef main-
10	4	W S W		6	u g	29·46	72	topsail.

Extract from the Log Book of H. M. Ship WARSPITE—*concluded.*

H.	K.	Courses.	Wind.	Force.	Weather.	Bar.	Ther.	Latitude and Longitude, and Remarks.
A.M.								October 29th.
3	2·4	S W by S	Southerly	6	u c			In 3rd reef main and close-
5	2	South	E S E	8	q r	29·10	70	reefed fore and mizen-top-
8	6	S E by E	N N E	9	q r	29·25	70	sail, down top-gallant-yards
11	8		N N W		q o	29·50	67	&c.; heavy sea running.
P.M.				8				Lat. 36°.20′.
4	8	S E by E	N W		b c	29·58		Long. 9°.11′.
8	6·4		Westerly	4		29·60	67	
12	8		S S W			29·60		

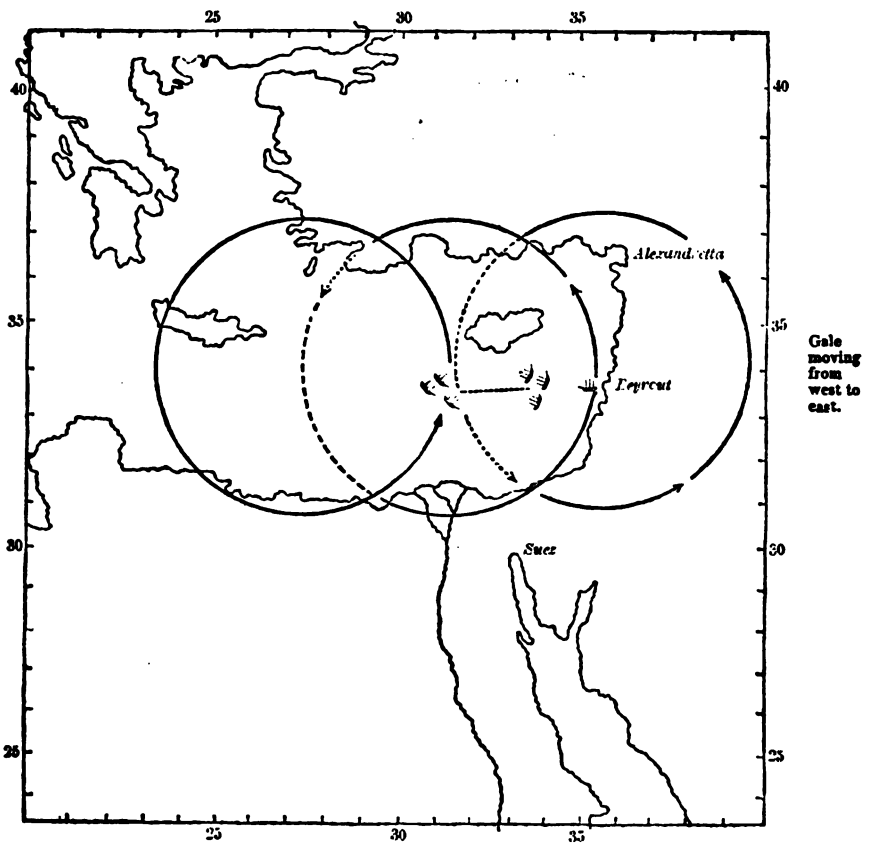
"In the morning running into the Straits of Gibraltar."

Storm in the Levant.

A storm passed over the eastern part of the Mediterranean, which seems to have come from the westward, on the 2nd of December, 1840, during the period of naval and military operations on the coast of Syria. H. M. ship Zebra was driven on shore and wrecked. The masts of the Pique frigate were cut away in order to save her. But this storm was rendered of particular interest from the circumstance of the Bellerophon, line-of-battle ship, Capt. C. J. Austen, dragging her anchors into deep water in the bay of Beyrout, Lat. 33°.45′ N., Long. 35°.32′ E., and being obliged to carry sail to prevent her from going on shore. This is another instance somewhat similar to that of the Madras hurricane, described at page 71, of a ship striving to gain an offing during a veering tempest on a lee-shore.

There is, however, this difference in the two instances, namely, that the Madras Storm, being within the Tropics, was moving from E. to W.; whereas the storm in the Levant was in latitude about 34°, and moving

CHAP. XI. from W. to E. It was the northern half of the Madras Storm which made the land of India a lee-shore; and it was the southern part of the Mediterranean Storm which made a lee-shore on the coast of Syria, at Beyrout, and to the southward of it. This will be easily understood by an inspection of the figure.



Marked by three ships. Part of the squadron under Sir C. Napier, in Lat. 33°.31′ N., Long. 31°.29′ E., marked in the diagram, had the weather calm on the forenoon of the 1st of December, 1840. Soon after midday, the gale reached

these ships. About 5 P.M. the ships of the squadron shortened sail, close-reefed topsails, and came to the wind on the starboard-tack, but wore on the night of the 2nd. Extracts from the log-books of the Vanguard and Rodney are annexed.

Referring to the log-book of the Bellerophon, it will be seen that the gale did not set in at the bay of Beyrout until nine or ten hours later than at the places of the Vanguard and Rodney. H. M. ship Magicienne was at Alexandretta (Scanderoon), in Lat. 36°.35′ N., Long. 36°.15′ E. This ship's log-book shows, that on the night of the 3rd the wind became S.E., and that it veered by S.S.E. to N.E. and N.N.E. Its greatest force was recorded by the number 6. Alexandretta is about a degree to the eastward of Beyrout, and, as the gale was moving easterly, it might be expected that it would reach Beyrout earlier than Alexandretta. Thus it is seen by the log-book of the Magicienne, that that ship did not lower her top-gallant-masts until 1.15 A.M. on the 2nd, and at 6.30 A.M. the sheet-cable was bent.

In the Benbow's log-book the swell of the sea is recorded as having been from the westward. By the figure, page 36, the swell would change from W. and become more northerly as the whirlwind gale advanced towards the eastward.

By the log-books of H. M. ships Asia and Castor, the wind at Malta was light and northerly. The barometer of the Asia on the 29th of November was 30·16, *and was then rising.* On the afternoon of the 2nd of December, and at the time the storm was at its height on the coast of Syria, the Asia's barometer had risen to 30·26.

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The following extracts from letters relating to the perilous position of H. M. ship Bellerophon, are taken from the Nautical Magazine. The first extract contains a narrative of the circumstances connected with that ship dragging her anchors and being obliged to put to sea.

The second extract is instructive, inasmuch as it relates to a ship on *the port-tack*, on a lee-shore in the northern hemisphere, and in the right-hand semicircle of a revolving gale, breaking off, until her head pointed on shore. The Bellerophon seems to have been very near the storm's centre, with the wind veering fast; for as soon as the ship was worn, and placed on the starboard-tack, the wind veered two points, enabling her to come up to S.S.W.

"*Bellerophon, Marmorice Bay, Dec.* 11*th*, 1840.

Bellerophon.

"I must briefly relate to you the chief circumstances connected with our recent providential escape from shipwreck, on the coast of Syria, not far from Latakia Point. During the night of the 2nd instant, the Bellerophon, then lying off Beyrout, and the Princess Charlotte, Benbow, Gorgon, Hydra, and Prometheus, two Austrian frigates and a corvette, a French corvette and brig, and sundry small merchant vessels, at anchor in St. George's Bay, a spot about three miles and a half from the town, deeper in the bight of the bay of Beyrout, where the holding ground was supposed to be better, and the position more sheltered by the land than the anchorage where we unfortunately were, a gale came on from the southward and westward in fierce gusts of long continuance, with heavy rain and much lightning. The weather became gradually worse as the night waned, and at 5 A.M., half an hour before daylight, the ship shouldered her two anchors, and carried them into deep water, when it became obvious that our only chance of saving her was to get her to sea, although that was a consideration associated with some 'chilling doubts and misgivings,' for we were fast drifting down the shore near the place of our old encampment at D'journie, and the extreme point northward of the bay extended along some distance before our

lee-beam. Nothing daunted, however, the cables were slipped, and such sail as the ship would stagger under was set without delay; and the noble craft, behaving admirably, as she always does under any circumstances, weathered the danger, and gave us reason to feel thankful for present deliverance, although leaving wide room for apprehension as to our ultimate preservation; for none could be insensible to the dangers which encompassed us, situated as we were with a long line of coast, much of it unknown to us, under our lee.

"The fury of the gale seemed to grow with the day, and before the sun had passed the meridian it was blowing a perfect hurricane, the sea running unusually high for the locality. The ship was then, as a matter of necessity, much pressed, having a close-reefed main-topsail and foresail set, which, had there been plenty of sea-room, would unquestionably have been furled. These, however, were rent into ribbons, and our lower masts were complaining, when it was deemed expedient to throw overboard five of the lee upper-deck guns, the ship then heeling 40°, the forecastle netting fairly buried in the water, and the lee-quarter boat also immersed in the deep. How the masts stood this was a matter of wonder to many who witnessed the scene. But the tragical part of the tale remains to be told.

"After the loss of the guns just named, the ship certainly did not give such heavy lee lurches as before, but the fall of our masts was still dreaded, and the weather still wore a most threatening aspect, the gusts being the fiercest that I ever experienced at sea, and of much longer continuance. No sail but a fore-topsail and mizen were set; our leeway was then calculated at four points, and our way through the water between three and four knots. This augured ill; and it was apparent to every reflecting mind, that if the wind did not shift more to the southward (it was then about W. S.W.), and enable us to lay up better on the larboard-tack, or come round from some other quarter to eastward of N., to afford us an opportunity of extricating ourselves, that nothing but a miracle could save us from being wrecked during the night on some part of the coast of Syria north of Tripoli. The sun set, and the gale remained unbroken; 8 P.M. arrived, no change; at 9.30 P.M. our destruction seemed inevitable. Ship not laying better than N.; 9.40 P.M. off to N.N.E., when the ship's company were made acquainted with their danger, and preparations made for cutting away masts and letting go sheet and spare anchors, in the event

Ship on port-tack, and falling off.

Wind veering fast.

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of our not weathering the point which we imagined to be Latakia, then close under our lee; at 9.50, off to N.E. *The immediate necessity for wearing the ship* and exercising a last effort to clear the land to southward on the other tack *became apparent;* up helm,—beautifully she answered it, and ere she was to wind again, it had suddenly veered in a heavy squall to N.N.W, observing which, the dawning of hope began to diffuse itself among us, and by midnight the gale had broken, and we were doing well.

See the General Kyd's log-book, page 74.

"This, you may readily fancy, was a very narrow escape! Seeing the land close under your lee in a heavy gale! It only remains for me to add, that a prayer of thanksgiving was offered up to that Omniscient One in our worship of Him (the following Sunday) whose interposition was alone able to rescue us from our helpless state of peril and perplexity. On the following morning we stood to the southward towards Beyrout. On the day succeeding fell in with the flag-ship off that place. From her we learned that our ships at Beyrout were safe, but that eight merchant vessels had been wrecked, some foundering at their anchors. The Austrian corvette was nearly lost, having drifted into the rollers a long way from beach, and lost her foremast; she has since been towed to Marmorice Bay by the Gorgon. Upon our arrival here we found, much to our surprise, the Commodore with all the Alexandrian squadron, except the Carysfort. It appears that they were a respectable distance off that coast in the gale, lying-to under a main-trysail without the bonnet. The Commodore declares that he never saw it blow so hard before. These ships felt it a good deal. The sad tidings of the loss of the Zebra, at Acre, have just reached the Admiral; she parted from her anchors and went on shore a complete wreck. All saved but three men."

Extract from a Letter published in the MALTA TIMES.

Bellerophon.

"At this time, during a most pelting storm of rain, the Captain sent for the ship's company aft, and told them the position of the ship; saying 'that much depended on their coolness and conduct, and to the attention paid to orders given.' The men went up with a will to bend fore and main-topsails; just at this time the wind *lulled for a moment,* and the ship broke off two points, *now heading right on shore,* not more than five miles off

Ship heading on shore.

it, some say only three. As our sole chance we put the helm up, and the Bellerophon wore where, perhaps, very few ships would; indeed, this fine ship behaved nobly through the whole way. After coming to on the starboard-tack, the wind came aft two points, the ship coming up S. S.W., and sometimes a point higher. We made all sail we could carry, rain and sleet still continuing, but wind a little abated. By 4 o'clock in the morning we were some ten miles off the land, and heading S.W. The watch was called, all hands had been on deck twenty-four hours. Upon the whole it was an extraordinary and very narrow escape from most imminent peril. Had the ship grounded she would have gone to pieces, and all hands must have perished. Nothing was to be found dry on board, the ship leaking from the tremendous straining during the gale, and the previous heavy fire during the campaign on the coast. The coolness of our chief, and the steadiness of the men, during this trying occasion, were beyond all praise. Thank God! we are now all safe, refitting and setting to rights in Marmorice harbour."

Wore.

Extracts from the Log of H. M. Ship VANGUARD.

Vanguard.

H.	K.	T.	Courses.	Wind.	Force	Weather.	Remarks.
							Tuesday, Dec. 1, 1840.
1	2	2	N N E ½ E	N W	7	b c m	A.M. 1.30, set foresail; observed Revenge ahead; up foresail.
2	2	4					
3	2	4					
4	2	6					4, Commodore N. 1½ mile.
5	2	..	N N E	.....	4	b c r	
6	1	4					
7	..	4					7, Up topgallant-masts and crossed fore-top-gallant-yards; made and shortened sail, as requisite to keep station.
8	..		.....		3		
9	1	..	N				
10	1	2	.....	Calm	0	b c	
11			N N W				
12	..	..	Southerly	Westerly	2	o r	Exercised a division at quarters. Noon, Powerful W.S.W. 1½ mile.

Change of wind.

Course.	Distance.	Latitude.	Longitude.			Bearings and Distance at Noon.
		D. R.	D. R.	CHRO.	LUNAR	
N 48° E	50	33°.31′ N	31	29	E	Alexandria, 31°W., 146 miles.

Extracts from the Log of H. M. Ship VANGUARD—*continued.*

H.	K.	T.	Courses.	Wind.	Force	Weather.	Remarks.
							Dec. 1—*continued.*
1	3	4	S S E	S W by S	6	b q p	P.M. In second and third reefs of topsails;
2	3	4					
3	3	..	.....	.....	5	b c m	rove new main-staysail
4	4	2	.....	.....	5	b c o	halyards, the old carried
5	2	4					away twice.
6	1	4					4.45, close-reefed top-
7	1	4	.....	Westerly	6	b c q	sails, and reefed the
8	2	4					courses; furled fore and
9	3	4	S S W	.....	8	o q r	mizen-topsails and main-
10	3	4					sail; sent topgallant-
11	3	4	.....	.....	6	b c	masts on deck; in fore
12	3	4	.....	.....	5		jib-boom.
							6, Commodore W.S.W.
							8.50, set foresail.
							Midnight, Commodore S. by W. 1.
							Revenge S.S.W. ½ mile.
							Dec. 2, 1840.
1	2	6	S S W	Westerly	10	b c q	A.M. Up foresail, set
2	2						fore-staysail, split main-
3	1	4	S W	.....	9		staysail, shifted mainsail,
4	1	4	.....	N W			carried away staysail,
5	1	6	S S W				down haul.
6	..	6					6.15, carried away main-
7	..	6					topsail-sheet, split the
8	..	4	.....	.....	10	b c q	sail; all canvas lost from
9	..	6	N N E	W S W	9	b c q r	four-reef, set main-trysail.
10	..	4					7.50, wore ship.
11	..	4					8, Powerful N. N.W. 2
12	..	4	.....	.....	..	b c q p r	miles; leeway 5 points.
							8.15, split main-stay-
							sail, unbent it, and bent another.
							10, split main-staysail
							stay-block in setting the sail.
							Noon, Revenge S.E. by E. Commodore N. Lee-
							way 5 points.

Gale setting in.

Middle of the gale.

Course.			Distance.	Latitude.	Longitude.			Bearings and Distance at Noon.
				D. R.	D. R.	CHRO.	LUNAR	
				32°.40′ N	31	55·45	E	Alexandria, 50° W, 136 miles
1	1	..	W by E ½ E	W N W	10	b o		P.M. Set main-staysail.
2	1	..						5, mustered at quarters.
3	1	..	N N E					Leeway 5 points. Power-
4	1							ful N. by E. 3 miles.
5	1	..	.....	N W	9	b m		8, no ship in sight.
6	..	4						11.30, in main-stay-
7	..	4	N by E ½ E					sail.

Extracts from the Log of H. M. Ship VANGUARD—*concluded.*

H.	K.	T.	Courses.	Wind.	Force	Weather.	Remarks.
							Dec. 2—*continued.*
8	..	4	.....	.....	9	o q	Commodore N. by E.
9	..	4	.....	.....	..	b c q	1 mile.
10	..	4					
11	..	4					
12	..	4					
							Dec. 3, 1840.
1	..	6	N E by N	N Westly			A.M. 3, set main-stay-sail.
2	..	1					
3	..	6	.....	.....	8	p c q	4, Powerful N. W. 1½
4	..	6	.....	.....	8	b c m	mile; leeway 5 points;
5	..	6	.....	.....	7	b c	found the truss pendant
6	..	4					carried away.
7	1						6.40, set foresail and
8	1						mizen-topsail.
9	1	..	.....	.....	6	c m	7.55, sent the remnant
10	1						of main-topsail on deck;
11	1	..	.....	.....	4	b c r	found 385 yards of canvas
12	1						blown out of it. See yesterday's log.
							Found broken, caused by the working of the ship.
							8.30, bent new main-topsail.
							10, set do. close-reefed; fitted a new truss pendant.
							Noon, Commodore N. by E. 3 miles.

Course.			Distance.	Latitude.	Longitude.			Bearings and Distance at Noon.
				D. R.	D. R.	CHRO.	LUNAR	
				33°.32′ N	33	8.45	E	Cape Gatte, Cyprus, North, 68 miles.
1	2	..	N E by N	N Westly	3	b c r		P.M. 1, wore, made, and
2	2	..	S W by W					shortened sail, as requisite.
3	1	4						4, out third and fourth
4	3	2	W S W	.....	4			reefs of topsails; found
5	2	..	.....	.....	3	b c m		the tiller-ropes stranded;
6	1	4	N N E					rove new do.; bent new
7	1	..	.....	.....	2	b c		main-trysail.
8	1	..	N E by N	.....	0			8, up courses.
9								Commodore N.N.E. ½
10								E. 1 mile.
11	..	..	.....	.....	1	b c		9, set courses and jib.
12								Midnight, Powerful N.N.E.; Revenge N.E. ¾ mile.

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Extracts from the Log of H. M. Ship RODNEY.

H.	K.	T.	Courses.	Wind.	Force	Weather.	Remarks.
							Tuesday, Dec. 1, 1840.
1	1	4	N N E ½ E	.....	6	b c	A.M. 1.50, Lat. by Chron. 35°.20′ N.
2	1	6					
3	2	..	N E ½ N	N W by N			2, Powerful N.E. by N.
4	1	4	.....	.....	2	c	
5	2						2.50, set fore and main-topsail. Commodore N.E. ½ N. ¼ mile; Powerful N. by E. ½ mile; Revenge and Vanguard in company.
6	1	4	.....	N W			
7	1	4					
8	1	..	N N E	.....	1	o	
9	1	..	N by W	.....	3	c m	
10	1	..	W S W	Variable	3	c	
11	1						8.40, carried away weather main-topsail; sheet-spliced do. Exercised at general quarters.
12	2	..	South	.....	4		Powerful S. S. W. 1 mile N.

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance at Noon.
N 27° E.	47	Obs. 33°.37′	Obs. 31°.17′	Alexandria, 24° E., 154 miles.

1	3	4	S by E ½ E	S W by W	4	c m	P.M. 4, Commodore S.E. ¼ S.; Cambridge N.W. by W. ½ W.
2	4	..	S E ½ E				
3	3						
4	3	..	S E by S	S W by S ½ S	6	q	5, close-reefed topsails, and struck topgallant-masts.
5	3						
6	4	..	S S E				
7	5	..	S by E	W S W ½ W			Powerful S. ½ E.; Cambridge W. ¼ N.
8	4	..	S ½ E				
9	3						8, Powerful S. by E.; Cambridge W. by N.
10	3	..	S by E	W S W		c q r	
11	3	..	S S W				10, Powerful S. ½ W. 1 mile; Cambridge W. by N. 1½ mile.
12	3	..	S by W ½ W	W			
							Dec. 2, 1840.
1	3	..	S ½ W	West			A.M. Set main-staysail.
2	3	4					2, Powerful S. by W.; down main-staysail.
3	3	2	S W by W				
4	2	..					4, Powerful S.; Cambridge E.N.E.; ship gave a heavy lee lurch, throwing up 2 cutter in mizen rigging, and, falling again with violence, carried away after-davit, and hung a wreck by the fore; unable to save her, cut her away clear of the ship.
5	1	4	S W by W	N W by W			
6	1	4	S W				
7	1	4	.....	.....	11	c p q	
8							
9	up	..	N by E				
10							
11	off	..	N E by N				
12							

10, gale increasing; got up fore and main-runners and extra lashings on booms and boats; double breeched lower-deck guns. Hands variously employed securing everything for a gale. Carried away main-top-staysail.

Rodney.

Change of wind.

Gale setting in.

Middle of the gale.

Extracts from the Log of H. M. Ship RODNEY—*continued.*

Dec. 2—*continued.*

Noon, Powerful N.N.E. 2 or 3 miles; Revenge S. by W. 2 miles.
9.45, insetting main-topsail, split the sail; clued it up and furled it.
Lost overboard, with the cutter, sails, boat, 2 in No., slings, chain, two pair of blocks, 5 in No.

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance at Noon.
S 44° E	67	Obs. 32°.57′ Ac. 32°.50′	Obs. 32°. 7′ Acct. 30°.54′	Cape Gavata, N., 24° E, 110 miles.

H.	K.	T.	Courses.	Wind.	Force	Weather.	Remarks.
							Dec. 2—*continued.*
1	..	..	up N	W N W	11	c m	A.M. Employed getting up preventer braces.
2							
3	..	..	off N E				Powerful N.E. by E.; Cambridge S. W. ½ S.,
4							
5	2	..	N N E ½ E	.....	8	b c	with a heavy sea; 5½
6	2	..	.....	N W			points leeway; this all
7	1	..	N N E				increasing, with a heavy
8	1						sea, the ship labouring
9	1	4	up N				very much; got up fore
10	1	4	off N E by N				and maintop pendants
11	1	4					and tackles, and bringing
12	1	4					them down abaft the fore and main-chains, and secured the main-deck ports.
							Midnight, Revenge the only ship in sight.
							Dec. 3, 1840.
1	1	..	N N E ½ E	N W by W	8	b c q	A.M. 4, Revenge E.S.E.,
2	1	..					the only ship in sight.
3	1	..	up N by E				Daylight, more mode-
4	1		.....	.....	7	b c q	rate; all the squadron in
5	1	..	off N E				sight.
6	1	..	N E ½ E				8, Powerful N.E. ½ E.
7	2						7 or 8 miles.
8	2	4	N E				9, out reefs of courses,
9	2	4	N E ½ N				set jib, and reefed spanker,
10	2	4					unbent main-topsail, and
11	3	4	.....	N W by N	5	b c	bent another; found miss-
12	5						ing from the upper-deck guns after the gale, tom- pions 32 pr. 6 in No., and 68, 2 in No.
							Noon, Powerful N.E. 5 or 6 miles; Cambridge S. S.W. 4 miles.

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance at Noon.
N 64° E	54	Obs. 32°.22′ Ac. 32°.14′	Obs. 33°.40′ Acct. 33°. 6′	Gavata, N., 84° E, 84 miles.

CHAP. XI.

Extracts from the Log of H. M. Ship RODNEY—*concluded.*

H.	K.	T.	Courses.	Wind.	Force	Weather.	Remarks.
							Dec. 3—*continued.*
1	4	..	N E by N	N W by N	4	b c	P.M. In main-trysail, out reef of driver.
2	4	4					
3	4	..	S S W				2.10, wore.
4	2	4	N E by N				4, H. M. ship Powerful S.W. by S.
5	1	4					
6	1	4	N by E				4.50, mustered at quarters.
7	1	6					
8	1	4	N E by N	Variable			Sunset, parted company with squadron.
9	1	4	N N E				
10	1						10, up mainsail.
11	1	..	N E by N	N W by N	3		
12	1	..	.....	.....	2		

Extracts from the Log of H. M. Ship BELLEROPHON.

Bellerophon at anchor in Beyrout Bay.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Ther.	L. W.	Remarks.
									Dec. 1, 1840.
1	...	..	.....	W N W	6	c	60		A.M. c.
2									4, c v.
3	...	..	.....	to					7, took the guard.
4									8, c o q r.
5									Employed variously.
6	...	..	.....	W S W	..	c r			Noon, c.
7	...	..	.....	.....	6	c o g r			
8	...	..	.....	N W	..	....	58		
9									
10	...	..	.....	Variable	1	c o			
11									
12	...	..	.....	.....	2	....	58		

Course.		Distance.	Latitude.		Longitude.			Bearings and Distance.
								Single anchor in the road, Beyrout.
1	...	..	.....	Easterly	2	c	58	P.M. c. 1.30, b v; loosed sails; hoisted in the second cutter to repair.
2								
3								
4								Sunset, c v.
5	...	..	.....	Variable	1			8, c r; observed a steamer in the offing.
6								
7								Midnight, c o q l.
8	...	..	.....	Southerly	2	c r		
9								
10	...	..	.....	S W	4	c o		
11								
12	...	..	.....	S West'y	5	c o q l	58	

Beginning of the gale.

Extracts from the Log of H. M. Ship BELLEROPHON—*continued.* CHAP. XI.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Ther.	L. W.	Remarks.
									Dec. 2, 1840.
1	...	..	.....	S W	5	q v	58		A.M. q o l. 4, heavy squall with rain.
2	...	..	.....	.....	6				
3									5.30, violent heavy squalls, with rain, and extremely dark; found ship driving, let go the small bower anchor cable, ran out to the clench; did not bring the ship up, ship having drifted into deep water; no bottom 120 fathoms; set main-
4	...	..	.....	.....	7				
5									
6									
7	...	..	NW by W						
8	7	..	.....	.....	10	q r		4	
9	7	4							
10	7	..	N N W						
11	7	..	½ W	S W by W	11				
12	7	..	.....	.....	12	q m	58	6	

Ship driving

into deep water.

trysail and mizen course; worse weather. Pilot left on shore at Beyrout.

6.30, slipped the ends of the cables; set foresail, fore-topmast and main-staysail; barge and pinnace swamped astern; set mainsail and main-topsail close-reefed; fore-topsail split in setting, furled it. Signals made to the Admiral, M R S C L V A B N.

Made sail.

8.30, fore-topmast-staysail blew to ribands; set fore-staysail.

9.30, mainsail split and blew to ribands; set main-trysail, it split, hauled it up.

11.30, a perfect hurricane, ship labouring heavily, and heeling more than 38° pendulum, could not indicate more, and mainmast complaining much; hove the lee, forecastle, and quarter-deck guns overboard—three 24-pounders, two 32-pounders, cannonades.

Heeling more than 38°.

Noon, blowing a perfect hurricane.

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
				Ras-al-Shakaa Point, or Cape Pondles, N.E. by E. 14 or 15 miles.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Ther.	L. W.	Remarks.
									Dec. 2—*continued.*
1	5	..	N N W	W S W	12	q r	58	6	P.M. Heavy rain, with violent heavy squalls of wind.
2	2								
3	2	4							
4	3	..	N by W	.....	10				1, split the foresail, set fore and main staysail, unbent remains of fore-sail.
5	2		.....	.....	..	q c r p l m			
6	2	4							
7	4	..	.....	.....	9				
8	3	4	.....	.....	8	q l r m			1.20, clue of main-staysail gave way; down do.; bent a new main-try-sail.
9	3								
10	2	6	.....	.....	7				
11	1	2	.....	.....	..	c q p l l			2, lee clue of main-topsail gave way; split the sail in getting it in;
	1	..	S W ½ W	N W	..	....			
12	3	..	SW by W	.....	8	c q		5	

Hurricane

Wind veering. Wore.

furled ditto; set main-staysail.

3, bent foresail.

3.30, set main-trysail.

4, set foresail reefed; wind not so violent; saw the land about Markab, N.E. by E. 14 or 15 miles.

5, close-reefed mizen topmast, and set it; land N.E. by E. ½ E., off shore about 12 miles.

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Extracts from the Log of H. M. Ship BELLEROPHON—*concluded.*

6, heavy squalls, with hail and lightning.
8, strong gales and squally; commenced shifting topsails; no bottom at 80 fathoms.
10.20, a heavy squall, with hail, thunder, and lightning to the northward; wind shifted to the N.W.; wore.
12, fresh gales and cloudy; getting fore and main topsails bent.

H.	K.	P.	Courses.	Wind.	Force	Weather.	Ther.	L. W.	Remarks.
									Dec. 3, 1840.
1	2	6	S W by W	N West'ly	8	b c l	58		A.M. Fresh gales and squally weather, with lightning.
2	2	4							
3	2	6	.....	.....	7				
4	3	..	W S W						2, set fore-topsail close-reefed; bent mainsail and main-topsail; set main-sail reefed, and main-topsail double-reefed.
5	4								
6	4	4	SW by W	.....	5	q			
7	4								
8	4	..	.....	.....	6				
9	4	..	.....	.....	..	b c			3.10, split mainsail, up ditto; set main-staysail.
10	3	..	.....	.....	5				
11	3	4	S W	.....	3				4, fresh gales and cloudy.
12	4	4	.....	.....	..	b v r	60		

Daylight, saw the land about Tortoga, from N.E. to E., off shore 12 or 14 miles; sailmakers repairing mainsail aloft.
8, fresh breezes and cloudy weather; fidded topgallant-masts and crossed topgallant-yards; out reefs of foresail and second reefs of topsails; set jib and spanker; up mizen.
9.30, set topgallant-sails; employed variously setting ship to rights, drying parts of sails, &c.
Noon, moderate and fine.

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
		Ob. 34° 31′ N.	Chr. 35° 27′ E.	Point of Tripoli E. by S., Point of Ras-al Shakaa S.E. ¾ E.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Ther.	L. W.	Remarks.
									Dec. 3—*continued.*
1	5	6	S W	N W	4	b v	60		P.M. b v; employed variously setting ship to rights after the gale.
2	5	4							
3	3	4							
4	2	6	.....	.....	3				4, b c; land from N.E. by E. to S. by E.; sail-makers repairing fore-topsail.
5	2								
6	1								
	1	2	S by E	N West'ly	2				
7	1	4							5.30, up mainsail and squared yards.
8	1	2	.....	Variable					
9	1								6, b c.
10	4								8, b c.
11	4	..	.....	.....	..	o b c	59		10, observed a steamer in the S.W., with a ship in tow without a foremast.
12	...	4							
									Midnight, b c.

Gale passed over.

Extract from the Log of H. M. Ship MAGICIENNE.

Days.	Wind.	Force	Weather.	Remarks.	
1840.					
Dec. 1	N W	...	c v	A.M. Out boats; loosed sails; sent boats	Magicienne at anchor at Alexandretta.
	....	1	c	for water; cleared hawse; employed scrubbing ship's sides.	
	N E			P.M. Received two Turkish soldiers	
		3		escaped from Egyptian prisons; employed watering.	
	S E	3	q o q	4.20, furled sails; received during the day 13 tuns of water.	
2	S E by S	3	c q	A.M. 1.15, down topgallant-masts.	
		6	c q r	6.30, bent sheet cable; sailmakers re-	
	S S E	5	g o r q	pairing main-topgallant-sail; arrived a	
		5	c m r	Bombard.	
		4	c p	P.M. 4.	
		3	u q p r l	6.	
		3	n t r l	8.	
		3	l c	Midnight.	
3	N E	4	c p	A.M. Loosed sails to dry; employed re-	
			c	fitting topgallant rigging, &c.; armourers at the forge; sailmakers repairing topgallant-sails.	
		2	b c	P.M. Unbent sails; shifted spanker; em-	
	N N E			ployed making up sails. Sunset, up boats.	

Such a roadstead or bay as that of Beyrout, may be secure at the commencement of a gale; but in extra-tropical latitudes as well as within the Tropics, a revolving storm may change the wind to the opposite point, and place ships on a lee-shore. It must therefore, everywhere, be a matter for consideration at the setting in of a storm, whether ships at anchor in roadsteads or open bays, should remain at anchor or put to sea.

It may be interesting to refer to the circumstances under which the ships put to sea from Madras Roads in October, 1842 (page 72), and to compare that instance with the case of the Bellerophon striving to keep off the Syrian coast. We may conclude from analogy, that most of the storms of the Mediterranean Sea come from the African continent, and they frequently

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bring with them dust, which falls upon the decks and rigging of ships.*

The storm tracks of the Mediterranean will probably, ere long, be as fully developed as those of the Bay of Bengal. With a squadron of ships in the Mediterranean, and British garrisons established in Gibraltar, Malta, and the Ionian Islands, and with consuls at the foreign ports, very great facilities are offered for tracing the nature of the storms of that inland sea. There is an American squadron there to join in an investigation first opened by their own countryman; and the French, from their Algerine possessions, are in a position enabling them to add greatly to the interest of this part of the inquiry.

* Law of Storms, 2nd edition, page 431.

CHAPTER XII.

ON THE NORTHERS OF THE GULF OF MEXICO, AND ON THE INFLUENCE OF COTEMPORANEOUS GALES ON ATMOSPHERIC PRESSURE.

In order at the same time to exhibit the labours of Mr. Redfield, and to show the storm tracks of the north-western Atlantic, I have re-engraved his chart of the courses of the Atlantic hurricanes, and placed it at the beginning of this volume. Mr. Redfield's tracks are marked by Roman numerals, to distinguish them from a few others which have been added. It is enlarged so as to embrace the European side of the Atlantic, and to include the Mediterranean Sea.

In addition to his former publications, Mr. Redfield has published, in Silliman's American Journal of Science for 1846, "*An Account of Three Atlantic Hurricanes, and of their Relation to the Northers of Mexico and Central America.*" The tracks of these three hurricanes are marked XII., XIII., XIV., on the general chart. The account in Silliman's Journal is accompanied by elaborate details confirmatory of his former views. That storm marked XII. was traced nearly across the continent of America, from the Atlantic to the Pacific Ocean, whilst the other two appear to have come from the Pacific across to the Atlantic Ocean.

Some of the violent north winds which blow in the Gulf of Mexico, are now clearly proved to be the left-hand side of rotatory gales; but there are others

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which it is not easy to reconcile with this theory. There is, perhaps, no sea in which it would be more interesting to pursue the investigation of the winds than the Gulf of Mexico. I shall here extract some of Mr. Redfield's remarks on the Mexican northers, and on the influence of cotemporaneous gales upon atmospheric pressure.

"*Description of the Northers of the Mexican Seas.*

"The descriptions hitherto given of the storms of this region, seem to be founded chiefly upon phenomena which have been common to particular parts of storms, while moving in certain routes or localities; and hence, as in the case of former descriptions of the West India hurricanes and the storms of the coast of the United States, they have failed to impart any satisfactory knowledge of the general history and progress of these storms.

"Mr. Mooney, an officer of H. M. ship Thunder, engaged in nautical surveys, made a passage to Honduras and Vera Cruz in the month of December, 1840, 'the very acme of the northers.' He says, 'When about forty miles from Vera Cruz, our forebodings (of the northers) were realized; we had one of the most severe gales, with the exception of a hurricane, that the West Indies produce, and arrived at Vera Cruz after three days' hard battering.' Sailing from thence to Tampico, he encountered another norther, commencing suddenly at N.N.E. Again on the 11th of January, he arrived in the middle of a heavy norther at Vera Cruz. Sailed on the 15th, was set to the south-east, '*and thereby escaped a gale that blew to the northward of us.* We had the *concomitant swell* as long and heavy as usual, but had only light winds and puffs, and dark lowering weather, *with a cross sea*, which effectually saved us the trouble of washing ourselves or the deck.' Of the norther, he says, 'Just before it commences the scud can be perceived progressing at no small pace from south-east to north-west.... I think it better for a vessel to keep as near the land as possible on these occasions. The wind blows more along shore: if weather and sky are clear, observations can be obtained. *The gale first lulls in shore, and the heavy dense bank* (of clouds) *can be seen about twenty or twenty-five miles out*, and there it hangs till the gale breaks altogether, enveloping many a hapless vessel in darkness, *whilst their more in-shore neighbours*

weather.'—The above is from the Nautical

de Orta, captain in the Spanish navy (who is rity by Humboldt and others), states that the the *norths* blow is from September to March, and t of the norths is regularly felt in the month of . In the winter months, after they begin they increase . in four hours or a little more, obtain their utmost n, with which they continue forty-eight hours; but after- s, though they do not cease for some days, they are mode- . They come on so frequently that *there are in general not ore than four or six days between them.* There are various signs by which the coming on of a norther may be foreseen; *but the most certain of all is the barometer,* which at Vera Cruz, in the time of the norths, varies eight-tenths between its highest and lowest range. *The descent of the mercury predicts the northers;* but they do not begin to blow (at Vera Cruz) the moment it sinks, which it always does a short time *before the north comes on.* Examples are not wanting of the norths happening in May, June, July, and August, at which times they are most furious, *being violent hurricanes,* and are called *Nortes del Muero Colorado. They begin at the N.E.,* flying round the compass, and *settling at N. N.W.* When the wind begins to veer again towards either the east or the west, the gale will soon be over.—(See Humboldt's New Spain, American Coast Pilot, Penny Cyclopedia, &c.)

"According to Humboldt, both the eastern and Pacific coasts of Mexico are rendered inaccessible for several months by severe tempests, the norths prevailing in the Gulf of Mexico, while the navigation of the western (Pacific) coasts is very dangerous in July and August, when terrible hurricanes blow from the S.W. At that time, and even in September and October, the ports of San Blas and Acapulco are of very difficult access. Even in the fine season, from October to May, this coast is visited by impetuous winds from N.E. and N.N.E., known by the names of *papagallo* and *tehuantepec.*

"It appears in like manner that the coast of Nicaragua and Guatimala, in the Pacific, is visited by violent south-west gales in the months of August and September, known by the name of *tapayaguas,* which are accompanied with thunder and excessive rains; while the *tehuantepec* and *papagallos* exert their violence during a clear sky.

"This seems to show that the so-called papagallos, tehuantepec,

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and norther of Vera Cruz, severally, are but the clear weather side of a revolving gale, like the north-wester of the coast of the United States; each in its turn being but part of a great vortical storm, which, in certain other portions of its area, or route, often exhibits an abundance of rain.

"Humboldt suggested that these northerly winds may blow from the Atlantic and Gulf of Mexico to the Pacific, and that the tehuantepec and papagallo may be merely the effect, or rather the continuation of the north wind of the Mexican Gulf and the *brisottes* of St. Martha. But the vortical character and determinate progression of violent gales was then unknown; and I cannot doubt that the northers which visit the Pacific coast and the Gulf of Tehuantepec *precede*, in point of time, the same storms in the Gulf of Mexico, and are identical with them, having, commonly in this region, a northerly progression.

See figure, page 14.

"Colonel Reid says, 'It is possible that the Spaniards may apply the terms nortes, or northers, to more than one phenomenon; but the violent north winds in the neighbourhood of Vera Cruz, are frequently no other than the left-hand side of rotatory storms, in their northerly progress across the Gulf of Mexico.' In this remark I fully concur."

"*Identity of Mexican Northers with the Storms of the United States.*

"When I first ascertained that many of the hurricanes of the West Indies had visited the Atlantic coast of the United States, and that here they had severally exhibited the common characters either of south-easters or north-easters, according as one or another part of the storm was presented to our observation, it became alike evident, that our storms were far more numerous and frequent than the hurricanes of the West Indies. It was known also, that the Mexican northers were of very frequent occurrence during our most stormy seasons of the year; while it seemed at least probable, that all great storms were governed by one and the same law, deriving their origin from the lower latitudes.

"But the presumption naturally arose, that the courses of these northers would be found generally parallel with the routes of the several storms which had been traced from the West Indies to our Atlantic coast, and that hence, they would, in most cases, prove to be identical with the storms that are found west of the Alleghanies, which sweep over the interior of the United States

and the British provinces; and to a large extent this is doubtless true. But the absence of sufficient observations from beyond the Mississippi, together with the inert character of many storms, and the always more intangible or indistinct character of such as pursue their course overland, has hitherto prevented their direct identification with the Mexican northers by consecutive observations. Nor was I sufficiently aware that the easterly progression of some of these northers, commenced in lower latitudes than in the previously-observed cases of the West India hurricanes.

"In October, 1837, the steamboat Home was wrecked near Cape Hatteras; and having afterwards occasion to investigate the causes of this disaster, I found that the catastrophe occurred towards the close of a north-east gale, that had previously visited the western and northern coasts of the Gulf of Mexico with great violence, and had passed from thence to the coast of North Carolina. In other words, this norther of the Mexican coast had become, in due course of progression, an Atlantic storm."

"RACER'S *Storm of Jamaica, Mexico, and Hatteras, in September and October*, 1837.

"On receiving the second edition of Colonel Reid's work* in February, 1842, I found that his attention had also been drawn to the 'northers,' and that he had presented valuable data relating to two storms, the Racer's hurricane of 1837, and the storm in which Admiral Solano's fleet† was dispersed in 1780, both of which he viewed as being related to the proper northers of the Mexican sea. On recurring to my records of the Home storm of October, 1837, for the purpose of completing these paragraphs, I perceive that this gale must have been identical with the Racer's storm of Colonel Reid. This extension of its observed route, serves to confirm the views which he then expressed; while it becomes important as connecting a norther of the Mexican coast with first a westerly, then an easterly progression, actually observed, and analagous in character to the known progression of the West India hurricanes. (Chart I., track XV.)

Figure, page 14.

"Colonel Reid's earliest account places this storm at Kingston, south side of Jamaica, on the 26th and 27th of September, where vessels were driven from their moorings in such manner as seems to show an easterly gale veering south-easterly. H.M. ship

* Law of Storms, 2nd edition, page 138. † Ibid. page 399.

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Racer took the gale at E.N.E. near the Grand Cayman on the 28th, which increased to a full hurricane. Noon of 29th, Lat. 19°.43′, Long. 83°.23′. At 7 P.M. was hove on beam ends, dismasted, and righted with 5½ feet of water in the hold. 9.30 P.M. again hove on beam ends, but righted immediately. Midnight, hurricane at its full height. At 2.30 A.M. of 30th, had veered to E.S.E., still in full force. Noon, Lat. 20.°12′, Long. 84°.42′, wind E.S.E., but little abated. October 1st, noon, Lat. 22°.22′, Long. 85°.36′, in Gulf of Mexico, near Cuba; gale abating. H.M. ship Ringdove, took the gale early on the 28th, blowing from the eastward, on the south side of Cuba, eastward of Trinidad. 29th, increasing from the E. Lat. 21°.21′, Long. 82°.56′, scudding to the westward. 30th, hard gale from E. Lat. 23°.13′, Long. 86°.32′, in the Gulf of Mexico. 7.30 P.M. shipped a heavy sea, stove weather-ports, and washed away the binnacles. October 1st, strong gales. 10 A.M. moderating, set close-reefed main-top-sail. Noon, Lat. 23°.16′, Long. 87°.48′, wind E.S.E., under main-topsail, trysails, and fore staysail. Morning of 2nd, fresh breeze and cloudy; breeze going down. On all this route the phases of the wind show the several observers to have been on the right-hand side of the storm's axis.

"I find that the schooner Active encountered this hurricane on the 1st of October, 47 miles N. of Sisal (about Lat. 22°.10′, Long. 90°.12′), which lasted thirty-eight hours, or, probably, till the morning of the 3rd. The schooner Pomona, which left Sisal in company with the Active, was dismasted by it. On the 3rd, the schooner Unber, from New Orleans, encountered this gale in the Gulf of Mexico, and was driven by it to Galveston Island, where we shall find it on the 5th. The schooner Cora, for Tampico, had the gale severe in Lat. 24°, Long. 93°, which lasted from the 1st to the 6th of October, and was greatly injured. On the 2nd, 3rd, and 4th, the storm was at Matamoros, on the Rio Grand del Norte, Lat. 26°, Long. 97°.30′, and along the coast, where it drove the vessels on shore, and prostrated all the buildings at the usual port of the Rio Grande. At Galveston, Lat. 29°.20′, Long. 95°, the hurricane drove nearly all the vessels ashore on the 5th, where they were left high and dry, as in the neighbourhood of Matamoros. The great influx of the sea on this coast during the gale, is evidently due to the force and extent of the easterly winds on the right-hand side of the storm, which, from the vicinity of Matamoros, was recurving eastwardly in its course.

"That the storm did not proceed far into the interior in a north-westerly direction from the Gulf of Mexico, is shown by the meteorological reports to the Surgeon-General from Fort Towson, and other western posts. In following its course eastwardly, we find that on the Sabine river, in Lat. 30°.51′, Long. 98°.33′, the storm, from N.E. and E., was at its height on the night of the 5th, and continued through the 6th. At New Orleans the gale or hurricane was severe on the 6th, hardest at evening, blowing from S.E. to S., and extending to Baton Rouge and Natchez; at which places it was easterly, and E.N.E., veering north. At Pensacola Bay it commenced on the afternoon of the 6th, from the eastward, and veered gradually to the S. on the morning of the 7th, and to the W. and N.W. during the day and evening. At St. Joseph's, West Florida, the gale was severe on the 7th and 8th, from E. round by S., ultimately to N.W., driving all the vessels on shore except one. At Fort Cass, East Tennessee, and in the upper counties of South Carolina, the storm was violent from N.E., veering N., on the 7th and 8th. The gale was on the coast of North Carolina, from the 8th to the 10th, blowing from N.E. and extending N. of the Chesapeake; with the barometer at New York, at a maximum of 30·73 in. on the 9th. From the Carolinas it continued its course on the Atlantic Ocean.

"The recurvation of this storm to the eastward, from near Lat. 26°, was even more sudden and abrupt than that of the Mexican and Bermuda gale from a lower latitude, which we have already considered. A like cause also for its sudden deflection and unusually eastern course is found in a *plus* state of the barometic pressure in more northern latitudes at this period. Thus, at New York, during the last ten days of September, 1837, the mean of my barometer was 30·324 in., and for the first ten days of October, 30·279 in.,* being for the twenty days ·216 in. above the mean for that year.

"When once the route of this storm from the Gulf of Mexico to the Atlantic Ocean had been ascertained, it was soon discovered that a similar course had pertained to many other storms from the same regions; but with great inequality as regards their frequency in different years. It was found, also, that this early recurvation of storms at some periods, and their easterly courses in lower latitudes, has an important influence on the

* Or a mean of 30·256 in. for the twenty days, *as corrected and reduced to* 32° *Fahrenheit.*

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weather and climate in the northern portion of the United States. This may be seen in the state of the barometer and weather, which we have shown in two important cases, cotemporaneously with the passage of storms over the southern states; and similar weather usually prevails whenever this peculiar course is pursued by the Mexican northers. For the intervals between our storms in the northern states are thereby increased in extent and duration; and hence it is that we enjoy those placid periods of autumn which are denominated *Indian summers*, of which the cases alluded to are striking examples.

"This peculiar course of a portion of the northers was uncommonly frequent in 1837, a year remarkable for the number and severity of its hurricanes. The autumn of 1845 has also been strongly marked by this peculiarity; with fine weather generally prevailing in the northern states, while severe gales have swept
See p. 265.
the Gulf of Mexico and thence over the Atlantic Ocean, touching Bermuda in several cases, in one of which the body of the storm is announced to have passed to the southward of this island. In fact, storms of this class are found to occur, with variable frequency, at almost all seasons of the year."

"*New England Storm of December 15th*, 1839.

"This storm may here be noticed as one of the numerous class of overland storms, which appear to come to us from the interior of the United States and the Mexican territories. In the south-western and western states this storm comprised the western division of a very extensive but not intense barometric depression, of some days continuance, and like many other storms, was but little distinguished for the development of its anterior winds. The fall of the barometer under these winds, in New York and the middle states, was only about half an inch below the mean of the year. The storm was chiefly remarkable for its violence in New England, on the left side of its axis; for the extent of the moderate and variable winds about its axis; for the short duration of the south-easterly and southerly winds of its right front; and for the great extent of westerly winds which were developed in the later part of the gale, which reached even to the border of the trade winds. The route of this storm is now placed on the
See plate prefixed to Chap. xiii.
chart (track XVI.) in conformity with extensive observations, obtained from the meteorological returns from the military posts, marine reports, and other sources

"A number of storms, of greater intensity and more strongly marked outline, may be shown to have pursued a similar course over the interior of our continent and from thence to the Atlantic Ocean. But our attention must next be directed to northers which come to the shores of the United States, not from Mexico, but from Central America, by a route more direct than has yet been considered."

"*Hurricane of the Honduras Sea, Cuba, and the Western Atlantic, in October*, 1844.

Track xiv.

"This remarkable storm, which I designate as the *Cuba Hurricane*, came from the direction of the Pacific Ocean and the regions of Central America. It appears to have entered upon the bay or sea of Honduras, which is the western arm of the Caribbean sea, directly from the countries of Honduras, Poyais, and Yucatan, on the 3rd and 4th of October. From the Honduras sea it passed over the island of Cuba, the southern part of Florida, and the Bahama Islands, and continued in a north-easterly course, to the Gulf of St. Lawrence and the island of Newfoundland, with a rapidity of progress hitherto unknown in American storms. It swept, in its progress, the salient portions of the North American continent on the one hand, and the eastern parts of Cuba and Newfoundland, together with Bermuda, on the other; while its pathway exhibited an amount of injury and destruction such as is rarely known in the annals of commerce.

"On the 1st and 2nd days of October, Cuba was visited with stormy weather, attended by an extensive and unusual fall of the barometer; and this depression of the barometer was mainly or partially continued after the gale had ceased, the weather remaining unsettled. I cannot trace, otherwise than barometrically, the progress of this prelusive storm on its departure from Cuba, except at Key West, and again in the higher latitudes; as will be seen hereafter. It was included, evidently, in a vast gyrative influence which comprised both storms; while the principal or most active vortex was developed in the subsequent hurricane. It will be found that the barometric depression of this earlier storm, continued to advance along the whole Atlantic coast of the United States, and over a wide extent of adjacent country. The probable influence of this advanced diminution of pressure, on the course and progression of the hurricane which followed, may be hereafter considered."

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"*Relations of the Cuba Gales to the Northers of Honduras and Yucatan.*

"Having previously shown that a portion of the great storms of the United States and the Atlantic Ocean are identified with the Mexican northers, several of which have been traced to the Atlantic, it remains to notice a like identity of the northers of Yucatan and Honduras with the storms which sweep over the island of Cuba and the Atlantic Ocean. The common name of northers has been applied to the gales which visit the northern coasts of Central America, as well as to those of Mexico, as far eastward as the Musquito coast and gulf and near to Long. 80°, over which region they are found frequently to occur, except in the summer months.

"From the Musquito coast to Cape Honduras (Long. 83° to 86°), when the wind gets 'to S.E. and then veers to S. and S.W., a gale will surely succeed.' These gales are very violent, and occur more frequently from W.S.W., W., N.W., than from north. Upon the Musquito shore, Honduras, and the eastern coast of Yucatan, the general winds are frequently interrupted in February and March by *norths*. In September, October, November, December, and January, the winds are from the northward or southward of west (north-westerly or south-westerly), with frequent gales from W.S.W., W., N.W., and N. On the northern and western coasts of Yucatan, the general winds are interrupted by hard northers, in the season of them.*

"That these northers of Central America move in a regular course of progression, like other storms, cannot well be doubted. In the case of the *Racer's* gale, we have seen that the course corresponds with the westerly progression of hurricanes which have visited the windward islands of the Antilles; while in the two Cuba storms, which have been considered, the north-easterly progression has been found commencing in the north-westerly portion of the Caribbean sea. A like course with the latter, I find, was pursued also by other hurricanes from the Caribbean sea, which have crossed the central portion of Cuba.

"A similar course, at least from the north side of Cuba, was taken by that destructive hurricane of the western Atlantic which passed the coast of the United States on the 11th of December, 1844. The hurricane which devastated the western part of Jamaica on the 3rd of October, 1780, also pursued a north-

* Derrotero de las Antillas.—American Coast Pilot, &c.

easterly course from the Caribbean sea, as I had occasion to notice in 1836, and has since been fully shown by Col. Reid, and is the most eastward of the storm tracks known to belong to this particular group. Of these storms which have thus crossed the island of Cuba, not one has been traced from the eastern portions of the Caribbean sea; and hence there is reason to conclude that they can only have belonged, locally, to the class of storms known under the appellation of northers, on the western borders of that sea.

"RELATIONS OF THE CUBA GALE TO CONTIGUOUS WINDS AND AERIAL CURRENTS.—These relations may be viewed, first, in reference to the rotation of the gale, and second, to its geographical progression.

"I have already referred to the natural tendency to a leftwise rotation in the winds of the northern hemisphere, when moving on the earth's surface from the equator towards the poles. But it is evident, from the prevalence of violent storms in some regions and their absence from other localities in like latitudes, that this general tendency of rotation does not serve to explain the actual distribution or prevalence of these storms. I have found, however, on a careful examination of marine journals, that this tendency to rotation is commonly shown, in some degree, in the successive phenomena and phases of the trade winds, in the region near St. Helena, and in other tracts of ocean which are exempt from severe storms. In some other regions, as in the western portions of an oceanic basin in the tropical latitudes, the Indian Ocean near Mauritius, and in the South Pacific from the Society to the Navigator's Islands, this tendency to a vorticular rotation appears to be directly promoted by local or specific causes, the most efficient of which are found in the actual courses of the several local winds or aërial currents, either in the same plane of the horizon, or at different elevations. Thus, Mr. Thom maintains, that the hurricanes of the Indian Ocean are due to the opposite or tangential action of the N.W. and S.E. monsoons on each other in that sea; and I apprehend, that the earliest activity and violence of the intertropical hurricanes may often be rightly explained in this manner.*

"This, however, cannot always explain the uniformity of the

* "In such cases, I suppose that extensive portions of these different or opposite winds may coalesce in a vast gyration, instead of pursuing their usually independent courses, stratiformly, without interference with each other."

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direction of rotation, nor the continued activity of the storms in their progress to other regions and in higher latitudes, where their greatest violence is sometimes developed.* Nor is the extraneous and tangential force of contiguous winds or currents at all necessary to the continued activity of the storm, when once the fall of the barometer and the involute vortical movement have been produced; for the pressure of the external atmosphere, around the basin of the storm, constantly aids or impels the involute movement at the earth's surface, and may be sufficient to maintain the existing vortical action, as may be seen in the case of a common vortex or whirlwind.

"We have seen that the two Cuba storms, as well as the Mexican northers, have appeared to come from the contiguous border of the Pacific Ocean. Now, are there any peculiarities in the winds and aërial currents of those regions, which may serve to induce or support a leftwise rotation in extensive portions of the lower atmosphere, while moving on or near the earth's surface? I apprehend there are such peculiarities, which have an extensive, constant, and powerful influence.

"First, we find on the eastern portion of the Pacific, from Upper California to near the Bay of Panama, an almost constant prevalence of north-westerly and westerly winds at the earth's surface. Next, we have an equally constant wind from the southern and south-western quarter, which, having swept the western coast or South America, *extends across the Equator to the vicinity of Panama*, thus meeting, and commonly oversliding the abovementioned westerly winds, and tending to a deflection or rotation of the same from right to left ↺. As this influence may thus become extended to the Caribbean or Honduras sea, we have next the upper or S.E. trade of this sea, which is here frequently a surface wind, and must tend to aid and quicken the gyrative movement ↺ ascribed to the two previous winds. And, lastly, we have the N.E. or lower trade from the Tropic, which, coinciding with the northern front of the gyration ↺, serves still further to promote the revolving movement which may thus result from the partial coalescence of these great winds of Central America and the contiguous seas.

"Thus, while a great storm is in part on the Pacific Ocean, its N.E. wind may be felt in great force on that side of the conti-

* "As in the case of the extremely violent hurricane near Lat. 59° in the eastern Atlantic, December 12th, 1844."

nent, through the great gorges or depressions near the bays of Papagayo or Tehuantepec, as noticed by Humboldt, Captain Basil Hall, and others, the elevations which there separate the two seas being but inconsiderable; and when the gyration is once perfected, the whole mass will gradually assume the movement of the predominant current, which is generally the higher one, and will move off with it integrally; as we see in the cases of the vortices which are successively formed in particular portions of a stream, where subject to disturbing influences. It is true, that different winds, which are found moving direct or obliquely towards each other in the aërial ocean, are never found to *meet*, in the opposing or antagonistic sense, any more than currents of the aqueous ocean; but they either stratify one upon the other when arriving on the same field, or else blend in a partial or common gyration and a united progression of their masses.

"There seems, then, to be sufficient cause why the prevailing winds of southern Mexico and Central America should assume an aggregated and sinistrorsal rotation, such as is successively exhibited in the northers and Atlantic storms; why the norther, originated in the dry wind of the Pacific coast, should, on first reaching the S.W. border of the Gulf of Mexico at Very Cruz, be found to afford little or no rain; and why these North American Storms should be distinguished for their almost regular *periodicity* of occurrence.

"PROGRESS OF STORMS DUE TO PREVAILING CURRENTS.—That the progression of these and other storms is caused by the predominant current in which they are imbedded, appears nearly a self-evident proposition; and there is much evidence of the prevalence of aërial currents which correspond to the courses pursued by the several storms.

"At the windward islands of the Antilles, we have seen that the course of the *lowest* trade winds is often from E. to E.S.E.; although, from thence to the northern border of the trades, it comes most commonly from the N.E. quarter. Mr. Lawson has shown us, that at Barbados, during a part of the year, the predominating course of the wind, both at the surface and in the region of clouds, is from E. to S.E.; and this is also the prevailing course of the higher portion of these winds in other months. His observations, which are confirmed by others, may be deemed to show the actual course which is there pursued by the great body of the trade wind, and thus may fully account for the west-north-westerly course which is commonly pursued by

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the hurricanes of the Antilles, while passing to the extra-tropical latitudes. In the United States and north of the Tropic in the Atlantic, the predominating currents come from the south-west quarter, which also corresponds to the courses here pursued by the great storms. I have now to maintain, that this prevailing south-west current exists far back in the intertropical latitudes, where it is derived, not from the trade wind of the Atlantic, north of the Equator, but, to a large extent, from the prevailing winds of the Pacific Ocean.

"In the lower latitudes, a general current from the south-west quarter has been noticed, as seen in the common course of the higher clouds, which pertain to the lower half of the atmosphere; while immediately below this current the upper portion of the trade wind is found to be from the south-east, as above noticed, and no longer moves towards the Equator, but becomes also, in due course of its progression to the higher latitudes, a south-westerly wind. This higher and main current from the south-west, coincides with the observed course of the two Cuba storms in the lower latitudes; and in its further progress and periodical variations, it also accords with the general course of the storms which have been traced in the temperate latitudes.

"That this predominant current is mainly or largely due to the prevailing winds of the Pacific Ocean, I cannot doubt. The great extent of north-westerly or westerly winds found on the eastern border of the Pacific *in the trade-wind latitudes*, has been noticed above, and a portion of this current appears to find its way to the southern parts of the Caribbean sea as a surface wind, at certain seasons. Without inquiring whether the higher portions of this current of the North Pacific may not unite with the westerly winds of the Atlantic basin, it may suffice to state, that on the southern coast of Central America it is not found within six or eight degrees of the Equator. On the contrary, we here meet with the vast stream of south-westerly winds, which have crossed the Equator from the southern hemisphere, where they constantly prevail, as the southerly winds on the coasts of Chili and Peru. That the lowest and most westerly portions of this current are deflected in the southern hemisphere and merged with the south-east trade wind, I do not doubt; but the main current still pursues its course, which is necessarily more towards the north-east on crossing the Equator, and in its further progress, as above stated, it is found superimposed on the westerly and other inferior winds of Central America and southern Mexico, and con-

stitutes the main south-west current which is so often recognized in the lower latitudes.

"There are two other extensive winds of the Pacific, of a character somewhat anomalous, which in their ultimate tendencies may serve to promote and strengthen this aërial movement to the North Atlantic basin: first, the great westerly monsoon, south of the Equator, which, even as a surface wind, is found to cross the greater part of the Pacific, from the Indian seas, in the principal season of the northers; and, second, the equatorial belt of westerly winds, which is so remarkable a feature in the aërology of that great ocean.

"The course of the great aërial stream into the Atlantic basin, after crossing the Equator from the southern hemisphere, is seen from other evidence than the reported courses of the clouds, and occasional surface winds. We learn from Humboldt, that in the great eruption of Jorullo, a volcano of southern Mexico, which is 2100 feet above the sea, in Lat. 18°.45′, Long. 161°.30′, the roofs of the houses in Queretaro, more than 150 miles N., 37° E. from the volcano, were covered with the volcanic dust. In January, 1835, an eruption took place in the volcano of Cosiguina, on the Pacific coast of Central America, in Lat. 13° N., and having an elevation of 3800 feet, the ashes from which fell on the island of Jamaica, distant 730 miles N., 60° E. from the volcano. The elevated currents by which volcanic ashes are thus transported, are seldom or never of a transient or fortuitous character; and these results, therefore, afford us one of the best indications of their general course. Thus the progress of the higher portion of the trade wind was marked by the eruption of Tuxtla, Lat. 18°.30′, Long. 95°, which covered the houses in Vera Cruz with ashes, at the distance of 80 miles N., 55° W., and also at Peroté, 160 miles N., 60° W. The ashes from the volcano at St. Vincent, which fell at Barbados and east of that island in 1812, mark the course of a current from the westward, which appears there at times, in the region of clouds, and may perhaps be connected with the permanent winds on the Pacific coast of Mexico. Few facts in meteorology are more worthy of our attention, than the stratiform character and the vast horizontal extension of the aërial currents in different portions of the globe.

"Over the United States and the temperate latitudes of the Atlantic, the course of this great south-west current is strongly marked, both by the movements of the clouds and the general course of the surface winds, notwithstanding the degree of

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obscurity which is induced by the generally revolving character of the lower winds; for even the north-easterly and north-westerly winds are found comprised in a general movement of the lower atmosphere towards the north-east. Thus, we find the great Cuba hurricane moving in this direction, with a progress of 500 to 1000 miles per day, overlaid and accompanied by a regular south-west current; and yet, if we should attempt to resolve the aggregate course and progression of this storm, solely by a general mean of its observed winds at the earth's surface, we might be led to very erroneous conclusions: for these rotary winds, instead of showing the true progression of the storm, might appear nearly to balance each other. Moreover, the winds of this storm, when considered locally, are found to exhibit nearly the same phases or succession of changes which are common to the temperate latitudes of the North Atlantic basin; which serves to show that our successively observed winds are commonly of a rotary character, and that the common method of estimating the mean resultant courses, or progression of the surface winds, is necessarily defective, and cannot show the true progression of the lower atmosphere.

"Some writers have described our northerly winds as sweeping from Canada to the Gulf of Mexico and Cuba, and thus reducing the temperature of the latter regions: but it is evident, that these persons have mistaken the cold winds which are found on the western side of our revolving storms, as being a direct current from the higher to the lower latitudes. I cannot find that the above geographical course has ever been pursued by the winds of this continent; on the contrary, in times of the greatest depression of the thermometer, in numerous instances, the cold period has been found to have first taken effect in or near the tropical latitudes and Gulf of Mexico; and has thence been propagated towards the eastern portions of the United States, in a manner corresponding to the observed progression of the storms.

"The only proper current of surface winds found coursing towards the Equator, in the temperate latitudes of North America, exists on the western side of the continent: but a high current from the north-west, which may have crossed the Rocky Mountains in its course, appears at successive and alternate periods, of considerable duration, in the higher region of clouds. Its direction nearly coincides with the closing winds of our revolving storms, and in the winter season, in some cases, it probably subsides to the surface and immediately follows these storms, for two

or three days, and sometimes longer. This will accord with views which have been expressed by the late President Dwight, and other writers: but I have in no case found the integral progression of a great storm to be in accordance with the specific direction of this wind.

"To my own apprehension, it is the constant course of the lower winds towards the Equator on the western shores of America, below the latitude of 40°, that best explains the aridity of those regions; and it is to a *counter* course of progression, in the lower atmosphere, that the United States, China, and western Europe, are mainly indebted for their rains and fertility, To these general and remote causes may also be ascribed, the varied electrical and hygrometric phenomena of these different regions."

Copious tables are given by Mr. Redfield, from which he ascertained the fall of the barometer at different distances from the centre of the gale, and in what degree the barometric pressure was influenced by cotemporaneous gales. From these elements he was enabled to determine approximately, the mean of the barometric curve through the central portion of the Cuba Hurricane transversely to its path. (XIV. on the general chart.)

In the next extract will be seen an example of what was alluded to at the beginning of Chapter X., namely, that whirlwinds when near each other, cause irregularities in the barometric pressure. It will show the importance of separately studying each barometrical oscillation; and it will prove, that extended observations alone afford explanations of the causes of those irregular barometric undulations, constantly occurring in high latitudes.

"*Phenomena of the Cuba Hurricane and Cotemporary Storms.*

"The extraordinary fall of the mercury in the barometer which takes place in gales or tempests, has attracted attention since the

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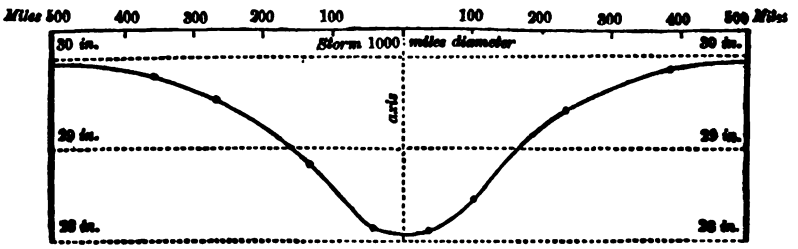
earliest use of this instrument by meteorologists. But I am not aware, that the principal cause of this depression had ever been pointed out, previously to my first publication in this Journal, in April, 1831, when I took occasion to notice this result as being obviously due to the *centrifugal force* of the revolving motion found in the body of the storm.

"Since that period, inquiries have been continued by meteorologists in regard to the periodical and other fluctuations of the barometer, and the relations of these fluctuations to temperature and aqueous vapour. But these incidental causes of variation in the atmospheric pressure prove to be of minor influence; and we are left to the sufficient and only satisfactory solution of this marked phenomenon, which is found in the centrifugal force of rotation.

"Mean Barometric Curve across the Centre of the Cuba Hurricane, transversely to its path, October 4th to 7th, 1844.—Vertical scale one-half.



"It is worthy of remark, that the barometric depression in this gale does not appear to increase according to the increase of latitude; showing that the proper effects of the centrifugal force of rotation are constantly found on the *centre path* of the storm, in all latitudes.

"The mean barometric curve on the centre path, in the direction of the storm's progression, appears not to differ essentially from that given above, so far as may be inferred from the various observations, except that on the posterior side of the storm the return of pressure, at some places, was apparently more rapid than its previous reduction. The contrary of this effect is sometimes seen in other storms.

"Thus, during successive days of the storm's greatest activity, and while passing through twenty-five degrees of latitude and near twenty-three degrees of longitude, we find an extraordinary barometric depression, the intensity of which increases rapidly

as we approach towards the axial area of this great progressive whirlwind, coinciding also, most remarkably, with the progress and intensity of the whirling action. We find, too, that the greatest intensity of the hurricane, and of its influence on the barometer, has no necessary connexion or coincidence with the local point of greatest rain or condensation: nor can any such coincidence at all lessen or contravene the known centrifugal force of rotation. To deny the proper influence of this force in rotatory storms, would appear equivalent to a denial of the great law of matter and motion to which the term is applied.

"The same law of centrifugal action must tend to produce an accumulation of pressure beyond the verge of the active whirlwind, or at least in the areas or spaces which separate distant storms. In the present case, the barometric curve, in front of the hurricane as well as laterally, is found to blend with the more advanced and extended depression of the first Cuba gale; and if we view the two centres of depression as comprised in one great area of gyrative influence, the accumulated exterior pressure, or summit of the barometric wave, will appear to be strongly exhibited, over a vast extent of surface, previous to the arrival of the storm.

"During the progress of the two associated Cuba storms, they are seen to have been immediately preceded, over this vast field, by a barometric wave or accumulation of pressure, rising above the usual or annual mean. An approach to this condition is seen also on the left flank of the two storms, and in the rear of the hurricane: but the decided inequality which thus appears in the wave of maximum pressure in front of these storms, as compared with their left border, together with the early disappearance of any excess on this border, in the Atlantic states, after crossing the thirty-first parallel of latitude, will be understood better when we take into view *another storm* which this extended inquiry brings to our notice. I will only remark here, that the areas or waves of cumulated pressure, which are thus found between distant storms, as well as the gyrative character of the storms and their extensive barometrical depressions, appear entitled to special consideration in estimating, relatively, the mean barometrical conditions of different zones of the same polar hemisphere.

"COTEMPORARY STORM OF THE GREAT LAKES AND THE ST. LAWRENCE, COTEMPORANEOUSLY WITH THE PROGRESS OF THE FIRST CUBA GALE.—The first decided barometric indication of this storm, we obtain at Fort Brady, at the outlet of Lake

CHAP. XII.

Superior, on the 2nd of October; from whence, advancing at the rate of about twenty-two miles an hour, we find its influence extending over the northern parts of the United States, Canada, and Nova Scotia, crossing the Gulf of St. Lawrence, and coinciding, in part, with the phenomena of the first Cuba storm. Its action, though widely extended, appears at first to have been moderate; and it was accompanied with light rain, which extended over Michigan and a part of Ohio, Pennsylvania, New York, and a large portion of the New England states. As the storm advanced in its course, its activity appears to have increased, and its barometric curve, *blended with that of the first Cuba storm*, becomes deeper, and, after a partial rising, is found to merge in the marked depression which attended the Cuba hurricane.

"Thus it appears, that two different storms may at one period, in the course of their progression, be found moving in the same geographical area, even when their several places of origin have been greatly distant from each other. Their convergence in such cases may result from different courses of progression, as well as from the convergence of the lines of longitude at increased distances from the Equator, and may be aided in some degree by the greater horizontal expansion or diffusion of the several storms, which is often found to take place in the higher latitudes.

The following remarks, on Mexican northers, I received through Vice-Admiral Sir Charles Adam, Commander-in-Chief on the West Indian and American station; from whom, as well as from all the naval officers on that station, I received the most cordial assistance whilst pursuing these enquiries.

"*Extracts of Northers experienced by H. M. Sloop* VICTOR, *off the Bar of Tampico.*

"18*th November*, 1840.—At anchor off the Bar of Tampico, in company with H. M. brigs Sappho, Racer, and a French merchant barque. At 4 A.M. heavy squalls, with every appearance of a norther exhibiting in the N.W., a dense black belt far along the horizon; the swell and sea quickly getting up; instantly prepared for weighing, which after some time we succeeded in doing, (our detention being in consequence of the heavy ground swell, and

from the chain messenger having been passed with a turn in it). The whole of the squadron were standing out, close-hauled on the larboard tack; by 5 A.M. edging off the land. The wind during the night had been light from the N.W., but now had veered more to the northward, and at noon might be considered about N. by W., or N.N.W.; the gale increasing with furious squalls and a heavy sea; the ship under a close-reefed maintopsail, storm fore-staysail, and fore and main trysails, making about 1½ mile per hour, and 6 per lee way. The greatest force of the wind in this norther was from N. by W., veering from the same to N.W. by W.; the ship labouring heavily. The Symp. at from 30°.40′, and Ther. 73°; the noon previous to the norther, Symp. 30°.28′, Ther. 78°.30′. The norther broke up in thirty hours from its commencement, the wind gradually hauling back to S. and S.S.E.; the Symp. falling to 30°.18′, and Ther. rising to 76°.30′; the squadron endeavouring to regain its anchorage.

"*24th November.*—From Tampico to Vera Cruz, stood off and on all night about 7 miles distant to the northward of the Light-house, St. Juan d'Ulloa. 7.50 A.M. ship under all plain sail, the wind increasing a little; took in flying-jib. At 8, moderate breezes and cloudy. 8.30, wind increasing rapidly; took in first and second reefs of topsails, weather evidently indicating a norther. At 8.50, hove-to, and received a pilot, filled and stood in between the reefs of the anchorage of Sacrificios; wind approaching to a gale, together with a swift scud, and clear lurid appearance to the northward; shortened sail; wind, which might now be termed a gale, was still increasing, the sea a perfect cauldron, boiling up and over the different reefs, and the whole space around, as far as the eye could trace, one mass of foam. 9.55, clued up, and came-to with both bowers, with sixty and sixty-six fathoms of chain, partly under shelter of the reefs, with an open hawse to the northward; furled sails, and struck lower yards and top-masts; secured and made ship snug for the gale. Noon, strong gales and fine, with a clear atmosphere, the wind N. by W. Symp. 30°.32′, Ther. 75°. At 6 P.M. the gale arrived at a terrific height, the pilot-boat swamped astern. 6.10, let go sheet anchor, and veered to eighty-four fathoms on both cables. The night awfully dark, and only illuminated by the repeated breakers dashing over the numerous reefs. Midnight, hard gales, with heavy squalls.

"*25th November.*—A.M. Ditto weather. 7.30, pilot-boat broke adrift; the weather continuing with almost unabated fury up to

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midnight, making about forty hours; the wind at the commencement of the gale N. by W., veering to N.W.; the Symp. rising to 30°.44′, Ther. falling to 65°.30′. As the Victor experienced several of these northers, the general features of which are perfectly in accordance with those already described, it would be needless to make any further remarks, save one or two connected with the current arising from them.

"First, we found generally, after a moderate norther, a strong set to the S. and S.S.E., about twenty-four or twenty-six miles in the twenty-four hours, but this is not always the case, or to be depended upon; as, on one occasion, we found ourselves, after two days, 111 miles to the northward of an assumed position, and which I consider arose from the following cause, viz:—should a norther continue for several days, I conceive that the immense body of water driven into and pent up in the gulf naturally endeavours to find a reflux, the gulf then being more than ordinarily pressed; and should a vessel be caught whilst out in the centre of the bay, would, I think, experience the current here described. It was generally found, that a southerly set took place when nearer the shore, no doubt arising from the sweep and tendency of the coast; but the currents here are at all times N. by E., mostly under the influence of the winds.

"Preludes generally announcing a norther, are,—First, a general humidity of the atmosphere. Secondly, the Peak of the Orizaba mountain visible and clear, the lower parts only being enveloped in dense, hazy clouds. Thirdly, the distant mountains far inland to the S.E. exceedingly clear, together with excessive heat and depression in the animal kingdom."

"*Remarks on the Storms called Northers. Gulf of Mexico, H. M. Ship* ELECTRA, 1842 *and* 1843.

"1ST—GENERAL OBSERVATIONS.—Previous to a norther coming on, the mercury in the barometer invariably fell, sometimes two, but always one day before, at which time the thermometer rose some degrees; weather sultry and oppressive. The night preceding the gale a copious wetting dew fell, wind S.E., gradually veering towards the south point. Whilst it remained east of south it generally blew a fresh breeze, which subsided as it went round towards the west; this we found always to have been its course, except in one instance hereafter

mentioned. A few hours before the gale set in, the wind drew round to W.N.W., N.W., and sometimes to N. A dense bank of clouds from N.N.E. to W.N.W., a few degrees above the horizon; sky over head B.C. When at Vera Cruz always observed the high land of Delgado to the W.N.W. becoming rapidly enveloped in masses of clouds, and it frequently fell a flat calm a short time previous to the norther: this, or a very sudden shift of wind from westward, was a certain indication of its near approach, when on it came in a moment with fearful violence, bringing down the sea like a wall in its train. We frequently observed, the evening before, the insect tribe to be particularly active, and during their prevalence to be very inert. The force of these storms is very variable, some not amounting to above No. 7, whilst we experienced one up to No. 9, and another to 10; this was the heaviest ever remembered at Vera Cruz. We commonly observed, that when the barometer gave the longest notice, the gale proved most severe. Their duration is also most uncertain, some blowing four or five days, others not lasting above twenty-four hours: the hardest gale was generally the shortest. They commence in October and last until April: those of December, January, and February are most severe. In the north part of the gulf these storms do not blow with anything like the violence they do towards the southern shores; I should say Vera Cruz is the very focus of them, nor do they extend any distance in shore. The great gale of the 14th and 15th February last, did not reach Yalapa, 40 or 50 miles from the coast, but sleet and snow fell there on those days. We observed, that they usually came on near the full, change, or the quarters of the moon, those happening at full or change being severest.

"2ND—PARTICULAR OBSERVATIONS.—The gale of the 8th December, 1842, was preceded by a fall of the mercury on the 4th from 30·10 to 29·84, Ther. 72°, wind N.W.; on the 5th, 29·84, Ther. 74°, wind S.E.; 6th, 29·84, Ther. 76°, wind S.E.; 7th, 29·87, Ther. 81°, wind S.E.; morning of 8th, 29·96, Ther. 78°, calm. Gale at 6 A.M., a saturating dew had fallen all night. [See the accompanying tables for progress of gale &c.] On the 31st January, 1843, we were assailed by a furious norther in Lat. 22°.36′, Long. 95°.48′ W., about 200′ north of Vera Cruz: the Bar. fell on the 29th ·05, Ther. 77°, wind S.S.E. [See table for further progress.] It will be seen, that as the gale approached the mercury in the barometer rose slowly whilst the thermometer fell; this we found to be the general case. This norther did not

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last more than twenty hours; and on our arrival at Vera Cruz, we heard it had visited that place about the same time and with great violence.

"The 14th February, at Vera Cruz, we experienced the heaviest norther of the season. It was preceded by a fall of the barometer on the 12th, of ·01, Ther. 74°, wind E.S.E.; 13th, 29·66, Ther. 78°, wind S.E.; 14th, 29·62 (this was the lowest notation made of that instrument during our stay in the gulf), Ther. 73°; the usual wetting dew had fallen; storm on at 5 P.M. The morning of the 15th it blew a furious tempest, the sea rolling in awful magnificence over the reefs, a white foam surrounding and flying over the ship. This gale lasted twenty-four hours, and did great damage, three vessels wrecked from upper anchorage, and several others seriously injured.

"On the 2nd of February another norther occurred; the barometer was very little affected by it, but a fall of the mercury took place the day before of only ·04. This gale formed an exception to the others we experienced, from the wind having backed from the eastward up to north, and N.N.W.; it was not severe, force 7, not of long duration. The wind blows in these storms from N. by W. to N.W. by N., seldom varying beyond these points.

"A. DARLEY."

"*Extract from the Log-book or Meteorological Journal kept on board H. M. Ship* ELECTRA.

	Date, 1842.	Wind.	Force.	Weather.	Bar.	Ther.	Latitude and Longitude, and Remarks.
	Nov. 10						
	A.M. 4	S S W	2	b c	29·98	81	22°. 38′ N., 87°. 29′ W.
	Noon	Calm	0	b c	29·98	81	Campeachy Bank.
	P.M. 8	N by W	7	c q	30·09	74	
	Nov. 19						
First norther.	A.M. 4	N	7	c q	30·15	72	
	Noon	N N E	7	c q	30·19	72	22°. 50′ N., 89°. 21′ W.
	P.M. 8	N N E	6	b c q	30·24	68	
	Nov. 20						
	A.M. 4	N by E	5	q	30·30	69	Lat. 23°. 10′ N., Long. 92°. 30′ W.
	Noon	N N E	5	b c	30·26	72	The norther commenced at 3 P.M.
	P.M. 8	East	6	b c q	30·25	74	suddenly; two days previously the barometric column measured 29·96, the Ther. 83°, the wind then S.E. and southerly.
	Dec. 6						
	A.M. 4	S Easterly	3	b c	29·84	76	Sacrificios.
	P.M. 8	S E	3	b c r	29·84	76	

Extract from the Log-book of the ELECTRA—*concluded.*

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Date, 1842.	Wind.	Force.	Weather.	Bar.	Ther.	Latitude and Longitude, and Remarks.	
Dec. 7							
A.M. 4	S Easterly	3	b c r	29·89	79		
Noon	S E	3	b c r	29·88	79		
P.M. 8	E S E	3	b c r	29·87	81		
Dec. 8							
A.M. 4	Calm	0	o g	29·96	78	Norther commenced at 6 A.M., down lower-yards and topmasts.	
Noon	N by W	5	b c r	29·98	76		
A.M. 8	N N W	7	c m	29·98	76		
Dec. 9							
A.M. 4	Westerly	3	b c	29·98	75	Wind lulled at 3 A.M., and again freshened.	Second norther.
Noon	N N W	7	b c				
P.M. 8	N W by N	7	c m	29·98	78		
Dec. 10							
A.M. 4	N W	3	b c	30·06	69	Wind lulled at 3.30 A.M., and again freshened; gale very heavy at 3 P.M. Norther heaviest about midnight; norther moderated shortly after noon.	
Noon	N N W	6	b c	29·97	69		
P.M. 8	N N W	9	c m	29·97	69		
Dec. 11							
A.M. 4	N N W	6	o g m	30·06	69		
Noon	N N W	6	c g	29·96	67		
P.M. 8	N N W	9	m	30·04	66		
Dec. 12							
A.M. 4	N W	8	c m	30·12	61	Shortly after midnight, weather became squally.	
Noon	N W ½ N	8	c m d	30·13	59		
P.M. 8	N W	2	o g m	30·18	61		
Dec. 13						Arrived mail steamer Dee.	
A.M. 4	N N W	6	c m	30·24	64		
Noon	N N W	6	c m	30·19	64		
P.M. 8	N N W	5	c m	30·25	65		
Dec. 14							
A.M. 4	N W	1	c m	30·25	64		
Noon	N W	1	c m	30·23	67		
P.M. 8	N W	2	c m	30·20	68		
1843.							
Jan. 30							
A.M. 4	S S W	2	b c	29·90	77	Off Tampico.	
Noon	South	5	b c r	29·86	76	Lat. 23°. 41′ N., Long. 94°. 50′ W.	
P.M. 8	South	6	b c v	29·84	76		
Jan. 31						Between 6 and 10 A.M. wind was	Third norther.
A.M. 4	S Easterly	3	b c	29·90	74	variable; norther commenced at	
Noon	N by W	9	c q w	29·96	76	10 A.M.	
P.M. 8	N N W	9	c	30·09	73	Lat. 22°. 36′ N., Long. 95°. 48′ W.	
Feb. 1							
A.M. 4	N N W	7	c g	30·29	63	Lat. 22°. 9′ N., Long. 90°. 10′ W.	
Noon	Westerly	6	c	30·30	67		
P.M. 8	Calm	0	c	30·26	67		
Feb. 14							
A.M. 4	S E	3	b c r	29·66	73	At Sacrificios.	
Noon	S W	4	b c	29·62		Norther commenced at 5.30 P.M.	
P.M. 8	N W by N	10	s q u	29·72	65		
Feb. 15							
A.M. 4	N W by N	10	c q u	30·10	61	Gale moderated, and again freshened about 8 A.M.	Fourth norther.
Noon	N W by N	10	c g q	30·19	61		
P.M. 8	N W	4	c g	30·02	68		
Feb. 16							
A.M. 4	N W	3	q	30·18	62		
P.M. 8	N N W	2	c g	30·21	66		

CHAPTER XIII.

GALES OF HIGH NORTHERN LATITUDES.

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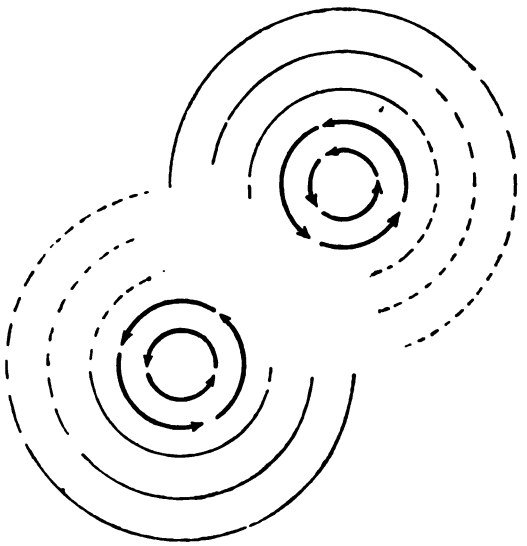
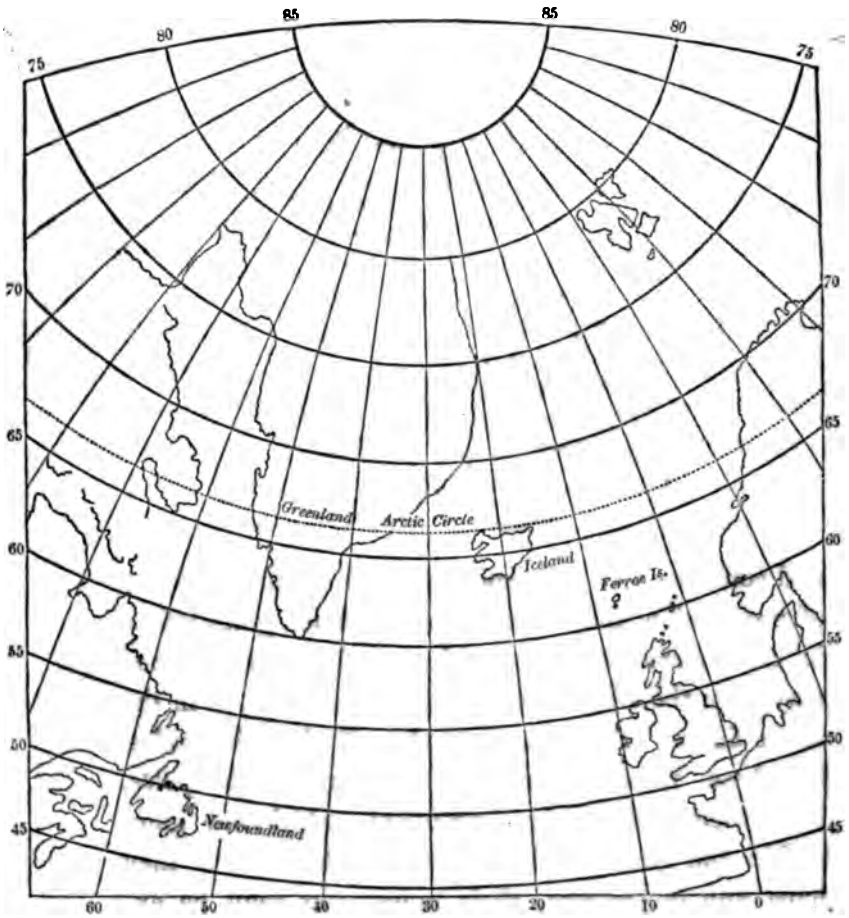
Proceeding step by step in the investigation of the revolving winds, following the enquiry from the thirtieth to the fortieth degree of latitude, and thence onwards to the fiftieth degree, the great oscillations of the barometer alluded to in Chapter II., are still found accompanying the veering of the wind, but with increasing irregularity as they are further removed from the Equator. Beyond the fiftieth degree, and over the British islands, the oscillations of the barometer, as well as the veering of the wind, become very irregular, and the study of the variable winds assumes, in a great degree, a new character. In the Attempt to Develop the Law of Storms, Chapter IX., it is stated, that gales succeed each other so fast, when passing over the British islands in the winter season, that it is not easy to identify any particular gale which it may be desirable to study. As storms proceed northward, even if they do not increase in diameter, they may be expected to meet, owing to the contraction of the meridians, and to neutralize each other, on the sides in contact, as represented in the next figure. From this same cause, gales may subdue each other and subside. If we conceive two gales of great extent to coexist on the same latitude, one of them on the meridian of Greenwich, and the other on the thirtieth degree of west longitude, which is the middle of the Atlantic,



and conceive both to be moving north at the same rate of progression, they would meet. When gales follow in close succession, overtaking each other, the one may have the effect of neutralizing the other, as in the above figure. The greater number of whirlwind gales, for these reasons, perhaps, never reach the poles. Nevertheless there are, probably, whirlwind gales within the Arctic and Antarctic Circles, but, if they have any progression, their movements may be expected to be very irregular. Mr. Carew Hunt, who has been at Archangel, informs me, that gales there sometimes set in at N.W. and end at S.E., which indicates a progressive movement from north-east to south-west: and it should be remembered that, when a whirlwind gale is without progressive motion, there would be no veering of the wind, although the barometer would fall. A diagram on the projection of the sphere is added, as more convenient for the study of this part of the subject than Mercator's projection.



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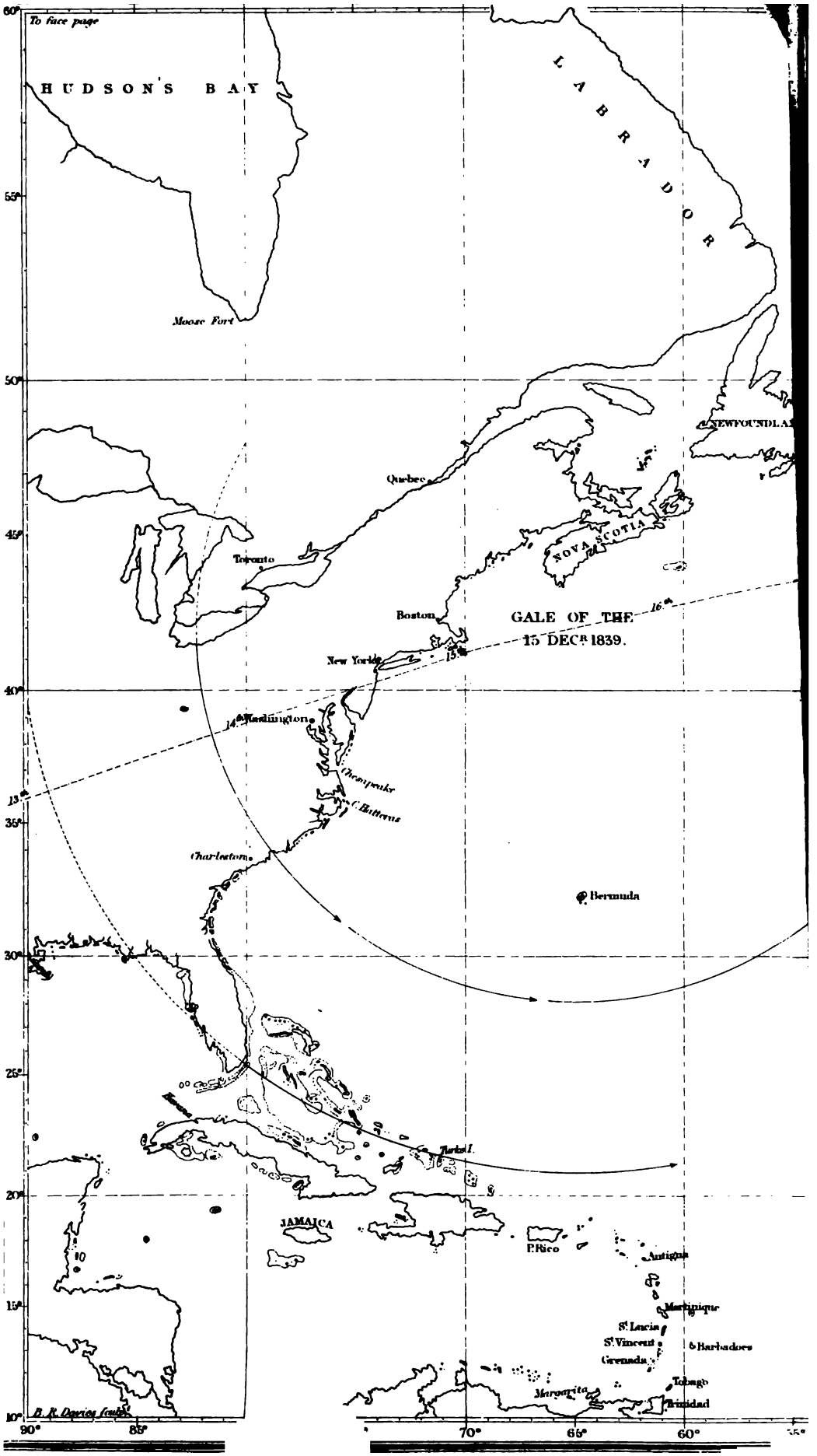
In the application of the Law of Storms to the explanation of the veering winds of high latitudes, this theory should be modified; and to apply it without considering what is stated above, would be to push the theory beyond its proper limit.

Mr. Milne's storms.

Whilst a great number of gales and storms have been tracked for more than two thousand miles in other quarters of the globe, little has been done to ascertain their courses on the European side of the


To face page
HUDSON'S BAY
LABRADOR
Moose Fort
NEWFOUNDLAND
Quebec
NOVA SCOTIA
Toronto
Boston
GALE OF THE
15 DECR 1839.
New York
Washington
Chesapeake
C. Hatteras
Charleston
Bermuda
Turk I.
JAMAICA
P. Rico
Antigua
Martinique
St Lucia
St Vincent
Grenada
Barbadoes
Tobago
Margarita
Trinidad
B. R. Davies fecit.
90°
85°
70°
65°
60°
55°
60°
55°
50°
45°
40°
35°
30°
25°
20°
15°
10°

Atlantic. The best paper which I have met with on this subject is by Mr. Milne, of Milne Graden, published in the Transactions of the Royal Society of Edinburgh, in 1839. Mr. Milne's paper is of much value, and I should wish to reprint it at length here, that it might be read in his own words, but it would occupy too much space.

It relates to two storms of November, 1838, following each other in quick succession. The first on the 26th of November; the second, and by far the most severe, on the 28th. Both storms are marked on the general chart, with a progression somewhat to the eastward of north. The severer storm, that of the 28th, Mr. Milne thinks, embraced at once a space occupying more than half the breadth of the Atlantic on the 50° of latitude, and, at the same time, extended to the eastward of Paris; and it is probable that this is really the extent of many of the winter gales of high latitudes.

See plate facing title-page

On reference to the weather tables kept at different places on the western side of the Atlantic, I find that the winter gale of the 15th December, 1839, traced by Mr. Redfield over the banks of Newfoundland, was of nearly equal extent to that of 28th November, 1838, traced by Mr. Milne over the British islands. As it is important to have correct ideas on the extent of winter storms, I have laid down the circuit of both these gales on the same chart, which is inserted here, in order that they may be compared. The gale of 1839 reversed the trade wind over the Bahama Islands, causing the wind to blow there from S.W., veering to N.W., with a force marked 5, and creating a heavy surf upon their shores.

Redfield's gale, Dec. 1839.

This is an example of the extra Tropical gales, which

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frequently, in the winter season, suspend the trade-winds in the West Indies, or reverse them, causing gentle breezes to blow there from the westward.

The influence of the same gale on the weather at Bermuda will be seen on referring to page 254, where there is a remark on the manner in which the surf beat first upon the western reefs, and later on the northern, thus marking the progress of the gale.

Perhaps the American gale of December, 1839, may have reached the British islands. On referring to the observations made at the Royal Society of London, I find the barometer had been rising for three days before the 23rd of December, 1839. At 8 A.M. on the 24th it had again fallen ·3 of an inch, and the wind became due south and high, with heavy clouds. Throughout the night following the wind is recorded as "very high." By the 28th the wind had veered round by the W. to N.W., the barometer rising, although irregularly, as the wind veered.

From LLOYD'S LIST, *Dec.* 1839.

"*Portsmouth, 24th Dec.*—It blew a very heavy gale all last night from S. S.W., with tremendous squalls.—*25th Dec.* It blew a severe gale last night from S.W., with heavy squalls.

"*Brixham, 24th Dec.*—It has blown a terrific gale at W. S.W. during last night.

"*Sheerness, 24th Dec.*—It blew a gale last night at S.W., during which the Elizabeth of Stockton broke adrift.

"*Stranraer, 25th Dec.*—Yesterday the wind suddenly shifted from S.E. to W., and blew a perfect hurricane for two hours."

If the distance travelled by the storm, between the 16th and 17th of December, be taken as the measure of daily progress of the storm across the Atlantic, that rate of progression will agree with its arrival at Greenwich on the 24th of December, 1839.

Mr. Milne's storms.

Mr. Milne gives a table, constructed from barometrical registers, kept at different parts of the United Kingdom. This table shows, that the sinking of the barometer on the 25th of November, 1838, first commenced in the southern parts of England and Ireland, and later in the north-eastern parts of the British islands, the difference in time being at a rate of from twelve to sixteen miles an hour.

Gale of 26th Nov. 1839.

He also shows, that the gale of wind which followed on the morning of the 26th, travelled northward, with its centre on the Irish channel, at a rate of about ten or eleven miles an hour; and that its shifting from E. to W., as it proceeded northward, occurred at different places in regular succession. In *England*, this gale veered from the E. by the S., whereas on the coast of *Ireland* it veered in the contrary direction.

From these reasons he concludes, that it came from the southward; and as there was a storm at Gibraltar on the 21st of November; on the coast of Portugal on the 22nd; and in the Bay of Biscay on the 23rd and 24th, he thinks it extremely probable that it was the same storm, which impinged on the south coast of Cornwall on the morning of the 26th of November, causing a gale of wind at E. to spring up there, so violent as to drive ships from their anchors. The wind of the first gale moderated in the south of England, on the afternoon of the 27th, with a light westerly breeze, and at night fell almost calm.

Bar. rising between the two gales.

Throughout the British islands, in the interval between the two gales, there was a temporary rise in the barometer. The second gale set in furiously on the morning of the 28th, shifting the wind suddenly from a light westerly breeze to a storm at S.E. At

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Gale of 28th Nov. 1839.

Hull, on the 28th, the first storm had abated at daylight, and during the whole day the weather continued moderate; and it was not till the evening that the second storm set in there. At Liverpool, and elsewhere, a transient calm occurred between these gales; but the investigations of Mr. Milne show that the second gale was moving faster than the first, so that it appeared to have overtaken the first, and that, at their place of contact, both became neutralized in the manner represented in the figure at page 321.

In the second storm, the wind veered everywhere over the British islands, from about S.E. to S.W.; and Mr. Milne concludes that the centre passed about 200 miles to the west of Ireland, moving on a N.N.E. progression at a rate of twenty miles an hour. He thinks that this storm, as well as that which preceded it, came from the southward. On the 23rd there was a storm at Madeira, which drove the ships there from the anchorage; and he computes that the rate of progress of nineteen miles per hour, would bring a storm from Madeira to the British islands within the time from the 23rd to the 28th.

At Lisbon, a storm set in on the night of the 23rd, blowing southerly; and at Oporto on the 24th, also southerly. On the chart inserted opposite page 323, I have laid down the track of the Great Western steamer on her voyage from New York to England. On the 28th, that vessel had a *heavy swell from* N.N.E., increasing as the ship sailed on. On the 29th, she had the wind blowing strong from W.N.W.; from which it would appear that the circles struck on the chart are within the compass of the circuit of this storm. Next day, December 1st, the Great Western had still hard

See fig. page 36.

gales and an increasing high *irregular sea*, after which the wind began to decrease, and became south-westerly.

The schooner Brandon, of Liverpool, marked on the map to the northward of the Azores, was nearer the centre of the storm than the Great Western, and lost her masts on the 28th of November, in a gale blowing N.W. Mr. Milne states, that at the same time that it was blowing N.W. with the Brandon, it was at Oporto S.W. or W.S.W.; at Royan, at the mouth of the Garonne, it was S.; at Paris, S.S.E.; at Greenwich, S.E.; in Perthshire, E. by S.; and at Coloony, in the north-west of Ireland, it was E.

But no abridgement of this paper of Mr. Milne's which I can make, would do justice to it; and those who wish to study the subject should read the paper itself.

If the two gales drawn upon the chart, inserted opposite to page 323, may be taken as fair examples of the extent of winter storms of high latitudes, it will be impossible for a ship to escape out of them: but by understanding their nature, ships may sometimes be saved from plunging deeper into storms of great extent, and sailing into their tempestuous vortices.

Gale of 23rd Feb. 1849.

In a lecture on storms, given by Mr. Milne, at the fishing town of Eyemouth, in Berwickshire, at which there was a numerous attendance of fishermen, Mr. Milne said that, "the most recent storm which he had investigated occurred on the 28th of February, 1849. Its centre passed in a N.E. direction up the Irish channel, and across the south of Scotland: its eastern segment affected severely the south of England, uprooting large trees, and causing wrecks, one of which was of an emigrant ship, with 160 passengers. Its

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effects were not so disastrous in Scotland, but its rotatory character was well developed there. At the observatory, on the Calton-hill, at Edinburgh, the gale began with the wind at S.S.E., and it veered round successively to S., S.W., W., and N.W. On the same day, it was blowing

At Kinnaird, Head of Bucchanness, from ..	S.E.
At Montrose	S.S.E.
At Edinburgh	South.
In Yorkshire	S.W.
At Pladda Lighthouse	W.N.W.
At Corsewell Lighthouse	N.W.
At Skerryvore Lighthouse	North.
At Islandglass Lighthouse	N.E.
At Pentland Skerries Lighthouse	East."

Mr. Milne added, "there could be no doubt, therefore, that this was a whirlwind storm, and that the direction of rotation was from right to left in the northern half of the circle."

The Nautical Inspector of the Peninsular and Oriental Steam Navigation Company, Captain Guthrie, informed me that this gale did not touch the coasts of Spain or Portugal. At Lisbon, on the 28th of February, the wind was light and from the N.E.; but two of the Company's outward-bound steamers met it in the English channel. The Sultan, the more powerful of the two, forced its way against the storm, and, after rounding Ushant, had fine weather and smooth water on the 1st of March. The Jupiter, a less powerful vessel, put back to Dartmouth, with some damage.

Mr. Milne, in his lecture, stated, that "bad weather in England is generally followed by bad weather in

Scotland—a fact which follows from the northward advance of storms."

Storm of 6th Jan. 1839.

A severe Atlantic storm, which passed over the British islands, first touched the west coast of Ireland on the 6th of January, 1839, and moved progressively about E.N.E. over Ireland, the Irish Channel, and Great Britain. I have been informed by Mr. Carruthers, of Lloyd's Committee, that he had traced it to Gotenborg, in Sweden, and this is the same direction many of the storms take which have been traced over North America and the Western Atlantic. I annex here an account of the manner in which the Royal Adelaide, Leith and London steamer, met this storm off the east coast of England; and I add some notes made by Mr. Carruthers at the time:—

"Royal Adelaide Steam-ship, Leith Roads,
January 5, 1389.

A prior gale passing off,

"5 P.M. Passengers and cargo all on board; a good fall of snow for last few days; the weather cleared up, with *falling glass;* determined to remain till midnight, but passengers getting dissatisfied at the detention, left at 8 P.M.; weather fine and clear, wind W.N.W.

and new gale arriving.

"*6th.*—10 A.M. off Tynemouth, wind died away, with light clouds rising in S.W.; *glass continuing to fall* (28·65). 9 P.M. off Whitby, wind freshened up strong from S.S.E. and S.E., with rain and heavy sea; kept a little more offing than usual, as sea was getting up from E.S.E. and S.E. Midnight, veered to S.W., strong gale; sighted Flamborough Head. 2 A.M. wind veered to W.N.W., and blew a hurricane (Symp. 28·40); sea very heavy, ship could not keep her course with safety, and kept her in best position to relieve her from the sea. 4 A.M. prepared to clear the decks of freight. At daybreak gale continued with more force, and we lightened the vessel by throwing over about forty tons of goods, principally butcher's meat; many ships around us in distress, could give no assistance, several of them foundering; the ship's head S.W. and W.S.W., wind veered gradually to N.W. and N.W. by N. 7 P.M. glass rose a little. 8 P.M. every

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appearance of change; set sail, and steered for Dudgeon Light. 9 P.M. weather more moderate.

"*7th.*—Midnight, struck soundings on Dudgeon shoal, and with strong wind from N.N.W. proceeded on our passage to London, reaching there on the 8th, at 4 P.M.

"The Clarence steamer left Leith six hours before the Royal Adelaide, and escaped the heaviest of the gale by getting under the coast of Norfolk. Previous to its commencement, the Duke of Wellington steamer, from Aberdeen to London, suffered severely by being more to the eastward, and had the gale longer. The Royal William and Leith steamers, from London to Leith, were caught in the same gale, and suffered much. The Royal William, by getting into Bridlington Bay on the 9th, escaped sooner than the Leith, which ship lost her rudder, and getting some considerable distance off the land, kept the gale many hours after it moderated (with the Royal Adelaide).

"WILLIAM ALLAN,
"Commander of the Royal Adelaide,
London and Leith Steam-ship."

The following are the notes made in 1839 by Mr. Carruthers:

"*Cork, 7th January.*—A gale commenced last night at 9 o'clock from W.S.W.

"*Gravesend, 7th.*—For the last 24 hours a gale from the W.

"*Deal, 7th.*—Blown hard all last night and to-day from W.S.W.

"*Ramsgate, 7th.*—Last night and to-day, a gale veering from S.S.E. to W., and at 8 P.M. W.N.W.

"*Chester, 7th.*—At 12 last night, commencing at 11, came on to blow from the S., flew at once to W.N.W. and a hurricane.

"*Boston, 7th.*—At 5 P.M. wind W.N.W., strong gales; it commenced hard from W. at 5 A.M.; at 6, it blew a hurricane.

"*Yarmouth, 7th.*—Gale at S.E. all this morning.

"*Yarmouth, Norfolk, 7th.*—Last night and this morning it blew a heavy gale at W. by S.

"*Weymouth, 7th.*—A gale last night from W.N.W.

"*Bristol, 7th.*—Strong gale since midnight up to 3 P.M., varying from W.S.W. to N.W.

"*Aberavon, 7th.*—Last night a severe gale from N.W.; this morning W.

"*Liverpool 7th.*—Wind all yesterday was E.; at 11 at night, suddenly veered to S.W. and W.

Hull, 7th.—Strong gales from W. Last night, at 12, heavy from S.S.W. 3 A.M. this day W.S.W., commenced Monday morning at 4; S.W. veered to W. until 2 in the afternoon.

"*Wisbeach, 7th.*—A gale from W.N.W.

"*Dartmouth, 7th.*—Heavy gale W.

"*Plymouth, 7th.*—Strong gale last night, S.W. veering to N.W.

"*Pwllheli, 7th.*—Last night, at 12, a gale W.N.W.

"*Bangor, 7th.*—Gale last night W. to W.S.W.

"*Beaumaris, 7th.*—At 9 last night S.S.W. gale; at 4 this morning shifted to W.S.W., and subsequently to about W. by N.

"*Mumbles, 7th.*—Last night, at 11, wind to W.N.W, from S.S.E. to S.W.; a gale.

"*Milford, 7th.*—Last night, at 8 A.M., gale from S.S.W. and S.W. 2 A.M. this day, W.N.W.

"*Sunderland 7th.*—A heavy gale this day S.S.E. to S.W.

"*North Shields, 7th.*—Tremendous gale from W. to S.W.; from W. to N.W.

"*Arbroath, 7th.*—Blew hard last night from S. and S.W.

"*Sligo, 7th.*—Heavy gale last night and this morning from W.N.W., from 9 till 2.

"*Westport, 7th.*—Last night a terrific gale from S.W. to N.N.W.

"*Galway, 7th.*—Gale at W. last night.

"*Belfast, 7th.*—At 10 P.M. last night, dreadful hurricane, commencing at 12 from W., and continued till 2 P.M. this day.

"*Drogheda, 7th.*—Last night, at 9, gale from S.W. until 8 this morning.

"*Leith, 7th.*—Heavy gale last night from S.S.W. to W.

"*Stranraer, 7th.*—At midnight, last night, gale S.W.; at 4 this morning, W.N.W.

"*Guernsey, 7th.*—Heavy gale at W. for last few days.

"*Portmllaen, 7th.*—Gale from W.N.W.

"*Strangford, 7th.*—At 12 last night W.S.W.; this morning, W.N.W.

"*Limerick, 7th.*—Gale last night, from 10 till 4 this morning, W. to S.W.

"*Campbelltown, 7th.*—Last night gale from S.W. to N.W.

"*Peterhead, 7th.*—Gale all day from N.W.

"*Islay, 7th.*—Commenced a gale this morning, at 4, from S.W., veered to N.W.

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"*Kilrush, 7th.*—Last night a hard gale at W., after midnight a hurricane.

"*Sheerness, 8th.*—For the last 48 hours a strong wind from S.S.E. to N.N.W.

"*Redcar, 7th.*—Early this morning, gale from S.W., and towards daybreak veered to W.

"*Portsmouth, 7th.*—Gale all last night from W.S.W., and veered this morning to W.N.W.

"*Brixham, 7th.*—Gale all night at W.S.W.

"*Lowestoff, 7th.*—Gale last night at S.W.

"*Swansea, 7th.*—Last night a gale commenced S.S.E., veering W.S.W. At 2 this morning a hurricane at W.N.W., and continued till 6 A.M.

"*Holyhead, 7th.*—Last night and this morning, gale from W.S.W. to W. by N.

"*Dublin, 7th.*—Gale at W. last night from 9 till 2 this morning; S.S.E. veering to S.S.W., commencing at 12.

"*Berwick, 7th.*—A hurricane at N.W.

"*Liverpool, 11th.*—Mary Sharp, arrived at this port from Calcutta, experienced a hurricane 6th instant, 500 miles W. of Cape Clear.

"*Greenock, 12th.*—Guiana, Hildrith, arrived here from Demerara, experienced, 6th inst., Cape Clear W. 9 miles, a dreadful hurricane.

"*Portsoy, 9th.*—It blew a severe gale 7th inst., N.N.W.

"*Montrose, 11th.*—On the evening of 6th inst., and throughout the next day, a hurricane W.N.W.

"*Youghal.*—An awful gale commenced on 6th, at 8 P.M., from W.S.W., until 4 A.M. of 7th.

"*York.*—At 11 on Sunday evening, 6th, fair until a quarter to 2, heavy rain, wind N.W., but not immoderately. At 3 the gale increased; at 4 a perfect hurricane; and between 5 and 6 was at its height.

"*North Shields, 13th.*—Captain Temple, of the Partizan, reports on Monday morning, 7th, at 10, Flamborough Head, bearing S.W. by S. 5 or 6 miles, met the hurricane.

"*Royal Exchange.*—Lamont, Havanah, at Cork on the 12th, reports that on the 6th, in Long. 16°, encountered a hurricane.

"*Londonderry, 8th.*—Yesterday morning, from 2 to 6, the gale was severe.

"Brilliant, Fitzgibbon, from Demerara, experienced a gale on 7th, off Cape Clear.

"*Annan, 14th.*—It blew a severe gale on 7th, from S.W. to N.W.

"*Donaghadee, 7th.*—It blew a perfect hurricane at S.W. last night.

"*Rutland Dungloe.*—On 7th a tremendous gale from half-past 3 A.M. to 4 A.M.

"*Flushing.*—The gale of 7th and 8th inst. was tremendous.

"*Amsterdam, 8th.*—It blew a strong gale yesterday from S.S.W.

"*Hornsea.*—Commenced about 3 in the morning of Monday, from 5 to 12 a hurricane.

"*Bridlington.*—Commenced at 3 A.M. of 7th.

"*Whitby.*—About 2 on Monday morning, S.S.W. to W. At 4, was at its height.

"*Troon.*—Commenced at 11 P.M. of 6th, S. by W., and veered to W. At 5, of 7th, a hurricane.

"*Preston.*—Commenced between 2 and 3 of 7th.

"*Hamburgh, 9th.*—It blew a violent gale last evening from S.W. to W.S.W.

"*Gottenburg.*—A gale commenced here on Monday night, the 7th, and continued unceasingly till Tuesday midday, from W. to S.W.; it was a tremendous storm.

"*Christiansand, 10th.*—It has blown a hurricane in the night between the 7th and 8th from S.W. to W.

"*Laurvig, 8th.*—Yesterday morning a severe gale commenced suddenly here from S.E., throughout the night S.W. Lat. 59° N., Long. 10° E."

In the Nautical Magazine for 1841, two storms of a rotatory character, which passed over the British islands, are described. The first, on the 13th of November, 1840, was moving about N.N.E.; the second, on the 17th November, 1840, was moving about E.N.E. The track of the greatest number of progressive whirlwind gales, which pass over the British islands, seems to be towards the north-eastward, but I am inclined to think that gales sometimes approach Great Britain and Ireland from the northward of west, and that this happens when there is unusually cold weather. This occurred on the 11th and 12th October, 1838, when a

See Law of Storms, 2nd edit., page 435.

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gale passed over Scotland as a snow-storm, causing likewise a fall of snow in the south of England.

A general atmospheric current from the north may perhaps be the means of deflecting gales from their usual tracks, sending them off in a direction south of east. The cold spring in England, of 1849, seems to have been owing to similar causes, for the end of March as well as the middle of April were in England unusually cold.

Ashley.

By a Journal of a Voyage from New Orleans to England, given to me by Mr. Alfred Gray, commander of the barque Ashley, that ship met a very heavy gale in Lat. 48° N., Long. 20° W., on the 27th and 28th of March, 1849, moving at the time with a progression apparently to the southward of east.

On the 26th, the barometer stood at 30·32, when it began to fall. On the 27th, the Ashley met this gale with the wind blowing N.W. by N., and ran on her course 130 miles by the log-line.

From the state of the crew, and the rapidly increasing force of the storm, it was with great difficulty the sail could be taken in. The barometer continued to fall, and the storm to increase in violence, until 8 A.M. on the 28th, when the mercury was down to 28·99. The journal states that "there was then '*a lull both in the wind and sea*,' and '*that it was clear overhead, but cloudy around the horizon.*'" At 9 A.M. the barometer began to rise. "From 8.30 to 9.30 the weather was quite moderate and clear;" after which time the gale set in again from N. by E., with heavy squalls and high sea, the wind veering, as it abated next day, to N.E. At noon on the 28th, the ship had made only thirty-seven miles by the log.

Storm's eye.

Had this gale been moving with a northerly progression, the ship would have continued to have a fair wind for England.

Another instance of the same kind is the following.

Iberia steamer.

On the 19th of April, 1849, the Iberia mail steamer, from England to the Mediterranean, encountered a gale in Lat. 47°.37′ N., Long. 6°.12′ W., in which the wind veered as in the following extract:—

"At midnight, on the 18th of April, the wind was N.W. Bar. 29·75, Ther. 53°. At 5 A.M., 19th, Bar. 29·50, Ther. 48°. Wind N.N.W. 8 A.M. wind N. Bar. 29·45, Ther. 46°. Noon, wind N. by E. Bar. 29·39, Ther. 47°. The gale heaviest at noon. 1 P.M. wind N.N.E. Ushant, N. 41° E., 68 miles. Noon, by observation, Lat. 47°.37′ N, Long. 6°.12′ W. The gale continued with unabated fury until 2 A.M. on the 20th of April, when the weather began to moderate. Bar. 29·75, wind N.N.E. Noon, 20th, Lat. Obs. 46°.40′ N., Long. 7°.30′ W.

(Signed) "R. D. GUTHRIE."

The barometer at the Royal Observatory at Greenwich, had begun to sink by noon on the 18th of April, 1849, and at 9 A.M. of the 19th, it had gone down ·7 of an inch. The northerly wind at Greenwich became south-westerly, veering by the S. towards E. and N.E., although with much irregularity.

Reading of the Barometer and Direction of the Wind, at the Royal Observatory, Greenwich.

Month and Day, 1849.	Hour of Reading.	Reading of the Barometer, reduced and corrected to 32° Fahr.	Month and Day, 1849.	Hour of Reading.	Reading of the Barometer, reduced and corrected to 32° Fahr.
		in.			in.
April 16	A.M. 9	29·669	April 17	P.M. 3	29·581
,,	Noon	29·654	,,	,, 9	29·643
,,	P.M. 3	29·645			
,,	,, 9	29·600	April 18	A.M. 9	29·772
			,,	Noon	29·762
April 17	A.M. 9	29·628	,,	P.M. 3	29·699
,,	Noon	29·615	,,	,, 9	29·510

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Reading of the Direction of the Wind—concluded.

Month and Day, 1849.	Hour of Reading.	Reading of the Barometer, reduced and corrected to 32° Fahr.	Month and Day, 1849.	Hour of Reading.	Reading of the Barometer, reduced and corrected to 32° Fahr.
		in.			in.
April 19	A.M. 8	*29·087	April 20	P.M. 3	29·491
,,	Noon	29·146	,,	,, 9	29·631
,,	P.M. 3	29·200			
	,, 9	29·311	April 21	A.M. 9	29·719
			,,	Noon	29·716
April 20	A.M. 9	29·424	,,	P.M. 3	29·722
,,	Noon	29·458	,,	,, 9	29·828

Month and Day, 1849.	Hour, or Interval of Time.	Reading of the Barometer, reduced and corrected to 32° Fahr.	Direction of Wind.	Pressure of wire in lbs. on the square foot.	Remarks.
Apr. 18	0 A.M.	.....	W S W		
,,	1 ,,	.....	S W		
,,	2 ,,	.....	S W		
,,	2½ ,,	.....	S W	2 lbs.	Snow was falling heavily during this interval of time.
,,	3 ,,	.....	W N W	4 lbs. to 5 lbs.	
,,	4 ,,	.....	N N W	5 lbs. to 8 lbs.	
,,	5 ,,	.....	N by W	2 lbs.	
,,	6 ,,	.....	N by W	½ lb.	
,,	7 ,,	.....	N by W		
,,	8 ,,	.....	N N W		
,,	9 ,,	22·772	N N W		
,,	10 ,,	.....	N W		
,,	11 ,,	.....	N		
,,	Noon	29·762	N by W		
,,	0.30 P.M.	.....	N W		
,,	0.40 ,,	.....	N by W		
,,	1 ,,	.....	W		
,,	1.30 ,,	.....	S W		
,,	2.30 ,,	.....	S W		
,,	2.45 ,,	.....	S by E		
,,	3 ,,	29·699	W S W		
,,	4 ,,	.....	W by S		
,,	5 ,,	.....	W by S		
,,	5. 3 ,,	.....	N W		
,,	6 ,,	.....	W S W		
,,	7 ,,	.....	W by S		
,,	8 ,,	.....	S W		
,,	9 till 12	29·510	S S W		
Apr. 19	0.20 A.M.	.....	S	from 3 lbs. to 5 lbs. very constantly	
,,	1 to 5 ,,	.....	S W to S by W		
,,	6 ,,	.....	E		
,,	7 ,,	.....			
,,	8 ,,	*29·087	N E		
,,	Noon	29·146	N E		
,,	1 P.M.	.....	N N E		
,,	2 to 5 ,,	.....	N		
,,	5 to mid.	.....	N by E		

The hurricane which occurred at Antigua on the 22nd of August, 1848, became a North Atlantic gale, and has been traced by Mr. Redfield. Its track will be found laid down on the general chart, marked XXI. At the Island of Flores, by a register sent me by Mr. Carew Hunt, it caused the wind to blow S.W., veering to N.W.; but its effect did not reach St. Michael's, for there the wind was N.E. and light.

Antigua Hurricane, 1848.

The September storms of 1848, in the Western Atlantic, took a more northerly course than the Antigua hurricane, which preceded them. One of these, felt at Barbados on the 19th of September, moved in the direction of the banks of Newfoundland: another was a violent tempest, and came from the Gulf of Mexico; and that also passed over the banks of Newfoundland. At the same period, the weather on the eastern side of the Atlantic was moderate and fine, but a long low swell coming from the N.W. was there met by the Medway mail steamer, on her passage from the West Indies to England; that swell, at first westerly, increased, and came nearly from the north on the 1st of October, on which day that vessel had reached Lat. 46° N., Long. 14° W. This swell was attentively watched by myself, on board at the time, as it was supposed to proceed from a gale at a great distance. Whilst the tempest was raging on the west side of the Atlantic, two barometers on board the Medway *rose* half an inch above their usual level, the weather at the place of the steamer being fine, affording an additional proof that the atmospheric pressure is augmented just beyond the limit of whirlwind storms.

Barbados Gale, 19th Sep. 1848.

Swell.

The following ships, all from Cuba, and insured at Lloyd's, have not been heard of since they sailed.

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These vessels were manned by about 200 seamen:—

"Hazard, 158 tons British. Cleared from Havanah, 25th August, 1848. 766 boxes sugar.

"Zaida. Cleared from Matanzas, 26th August, 1848. 1252 boxes sugar.

"Isabella Cooper, 371 tons, British. Cleared from Havanah, 30th August, 1848. 2700 boxes sugar.

"Sharon, 287 tons, American. Cleared from Havanah, 30th August. 1537 boxes sugar.

"Havanna Packet. Cleared from Matanzas, 31st August, 1848. 1191 boxes sugar.

"Lahore, 260 tons, British. Cleared from Matanzas, 31st August, 1848. 1360 boxes sugar.

"Madelina Greenfel, 314 tons, British. Cleared from St. Jago, 15th August, 1848. tons copper ore.

"Alicia, 349 tons, British. Cleared from St. Jago de Cuba, 1st September. tons copper ore.

"Hong Kong, 545 tons, British. Cleared from Havanah, 9th December, 1848. 2922 boxes sugar, value £13,200; ship's value, £8000; freight, say £2500; total, £23,700.

"Kinmore. Cleared from 2nd December, 1848. 1413 boxes sugar.

"Auricula, 321 tons, British. Cleared from St. Jago, 20th November, 1848. tons copper ore.

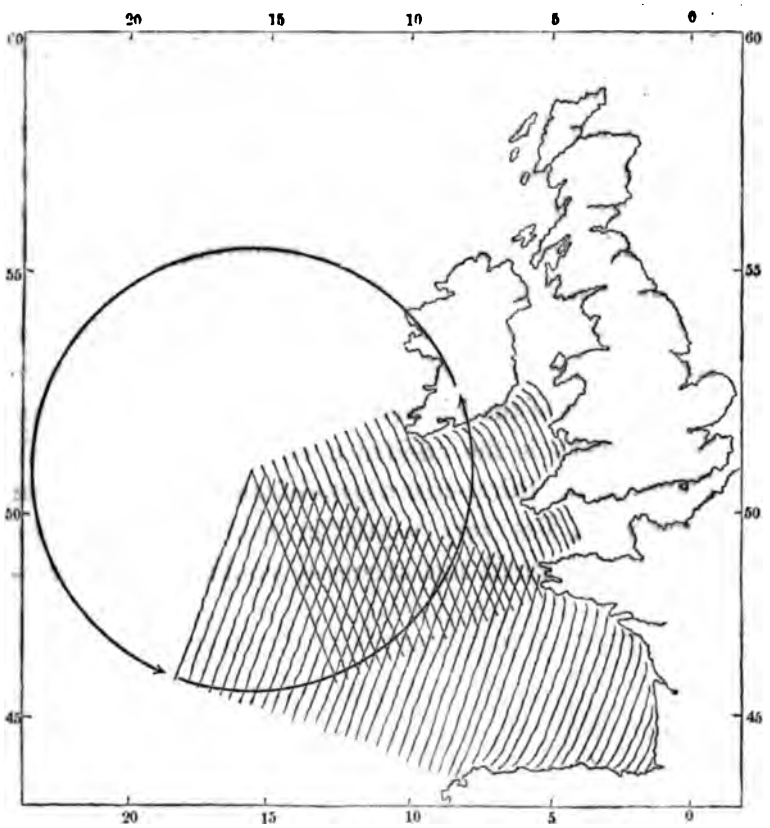
"Mary Dugdale, 375 tons, British. Cleared from St. Jago, 26th November, 1848. tons copper ore."

Swell of the Bay of Biscay.

The figure opposite will show, how passing storms cause a very heavy swell to roll into the Bay of Biscay, and how a coming storm sends a heavy sea before it, which breaks upon the south-western coasts of Ireland and England. Such indications as these, when combined with the observations of the barometer, may become still more useful than at present to fishermen on the coast, as well as to seamen, when the causes of these signs in the weather are explained, as was recently done at the fishing town of Eyemouth, by Mr. Milne.

Storm currents.

Mr. Piddington thinks that the indraft occasionally



observed on the coast of Portugal, which has caused ships to be wrecked on that coast, is the consequence of the storm-wave created by diminished atmospheric pressure; and if gales have sometimes a south-easterly progression near the Azores, the indraft might on such occasions be expected to set strongest towards the Portuguese coast. CHAP. XIII.

In the year 1840, Mr. Carew Hunt, British Consul at the Azores, assisted by the vice-consuls at each of the islands, kept registers of the weather, which will be found condensed, and published in the Nautical Magazine for March, 1842. Mr. Hunt is of opinion, Observations at the Azores.

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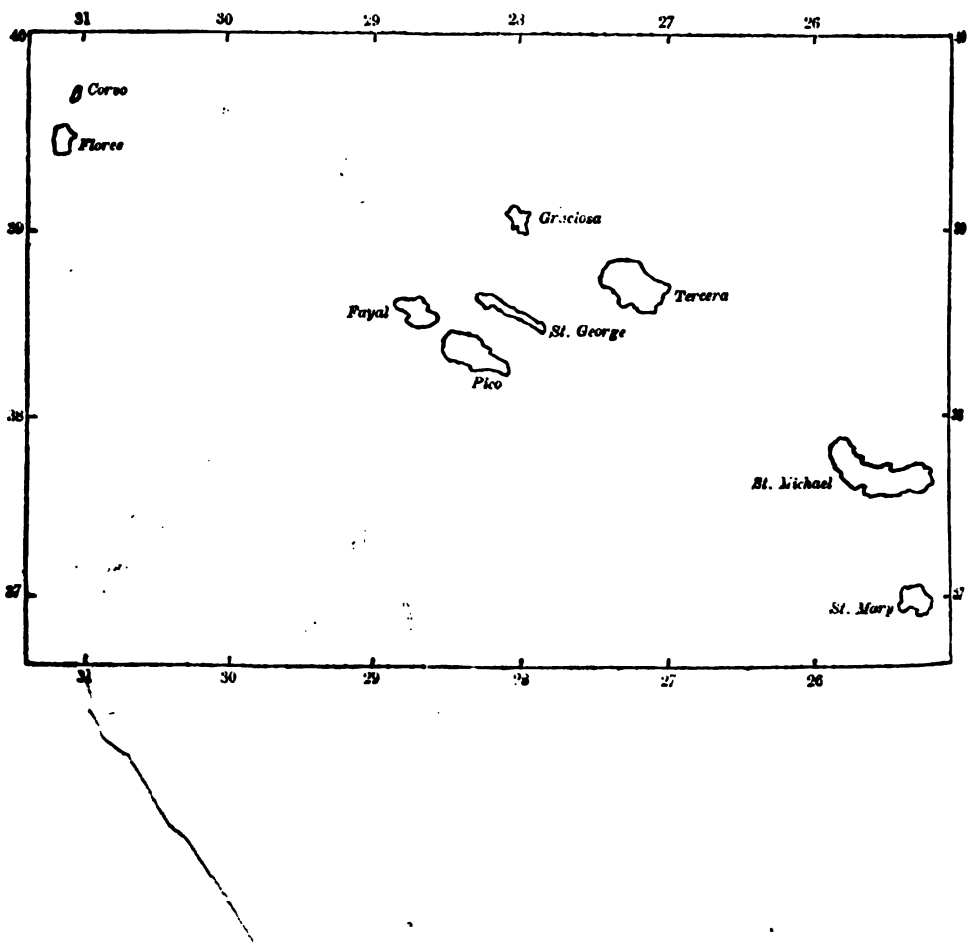
that many of the gales which pass over the Azores have a south-easterly progression, a point which it is very desirable to have further investigated.

That gentleman is still pursuing his observations. The Azores extend through six degrees of longitude, and their situation is particularly favourable for the observation of the progressive revolving gales of the Northern Atlantic.

A map of the Azore Islands, on a larger scale than the general chart, is given here, in order that the relative position of the islands may be more distinctly seen. St. Michael's is the residence of the British Consul. Flores, in the thirty-first degree of west longitude from Greenwich, lies very nearly in the middle of the Atlantic. A small sum of money would furnish meteo-



rological instruments and ensure regular observations; and perhaps this may some day be contributed by societies which aid meteorological enquiry.

Mr. Carew Hunt has endeavoured to interest persons, residents in Spain and Portugal, as well as masters of ships navigating between Portugal and the Azores, to assist him in tracking the progress of storms. No doubt when the value of the enquiry is understood by the American and British consuls, and merchants resident at the ports of Spain and Portugal, they will contribute their aid in connecting the observations made at the Azores, with observations made on the west coast of the Peninsula.

Iceland and Ferroe islands.

The small chart placed at page 322, exhibits the positions of the Island of Iceland and the Ferroe Islands, and it shows how well these islands are situated for observing to what latitude North Atlantic storms may reach. The difference of language spoken by the nations on the European side of the Atlantic has retarded these investigations, whereas on the western side the English language is spoken from Guiana to Labrador. We may, however, hope that Professor Dove, of Berlin, and other eminent continental meteorologists, will trace the courses of European storms, and delineate and publish their tracks.

The gales of high latitudes should be regarded as forming a separate study, the progressive whirlwind storms, tracked in lower latitudes, being looked upon as a key to that study.

CHAPTER XIV.

THE APPLICATION OF THE LAW OF STORMS TO NORTH ATLANTIC VOYAGES.

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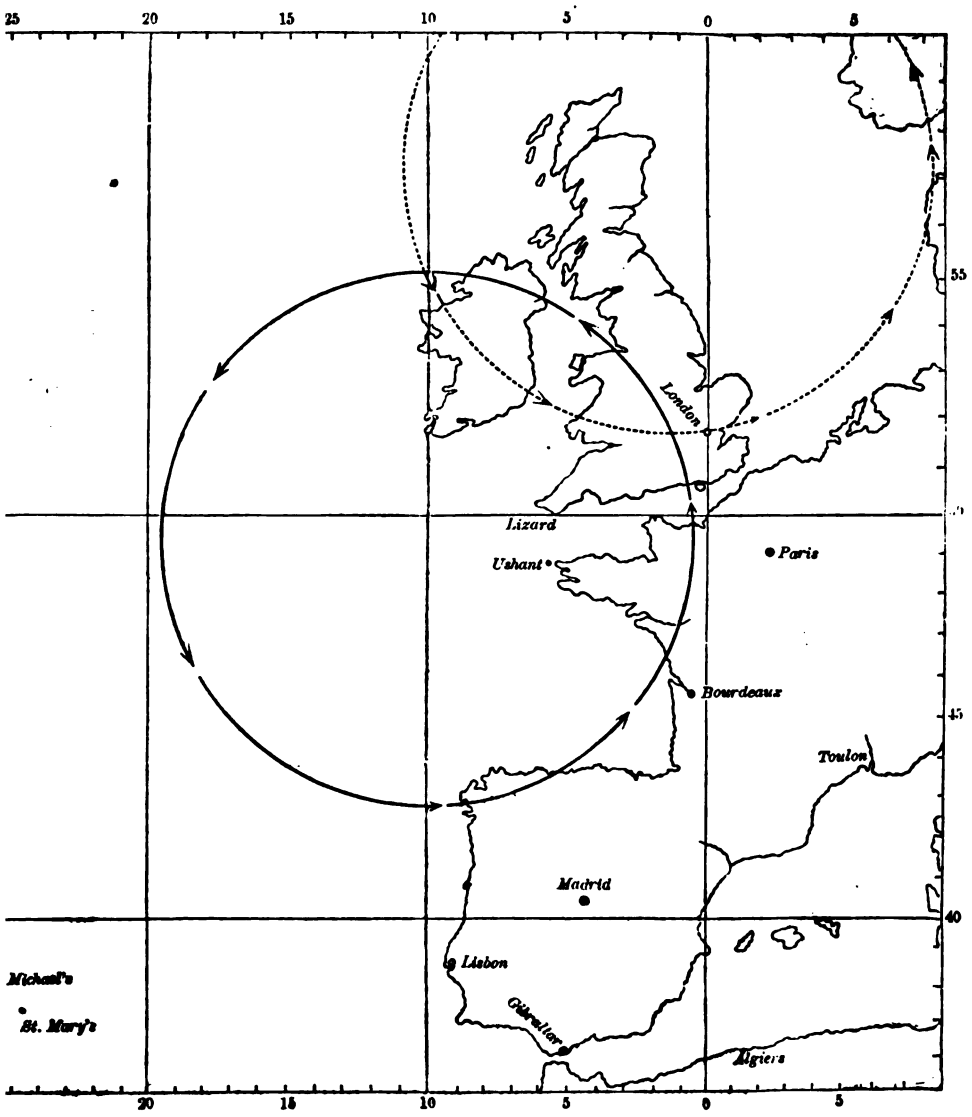
WHEN revolving gales are moving on a *north-easterly* progression over the British islands, it will be the first half of the gale which will give an easterly wind, or a fair one for sailing west from British ports. It is of importance to take advantage of the earliest part of the circuit of the wind after the change of wind to the eastward; for, when half the gale has passed over, the wind will become westerly, and this sometimes happens before ships are clear of the land and the narrow channels. On the 6th of January, 1839, the wind becoming S.E., several very valuable ships sailed from Liverpool. The progressive storm traced by Mr. Carruthers, page 329, was at the time setting in on the west coast of Ireland; and the ships alluded to were wrecked, not far from port, when the wind changed to the westward. It is on such occasions as this that the barometer is of the greatest value.

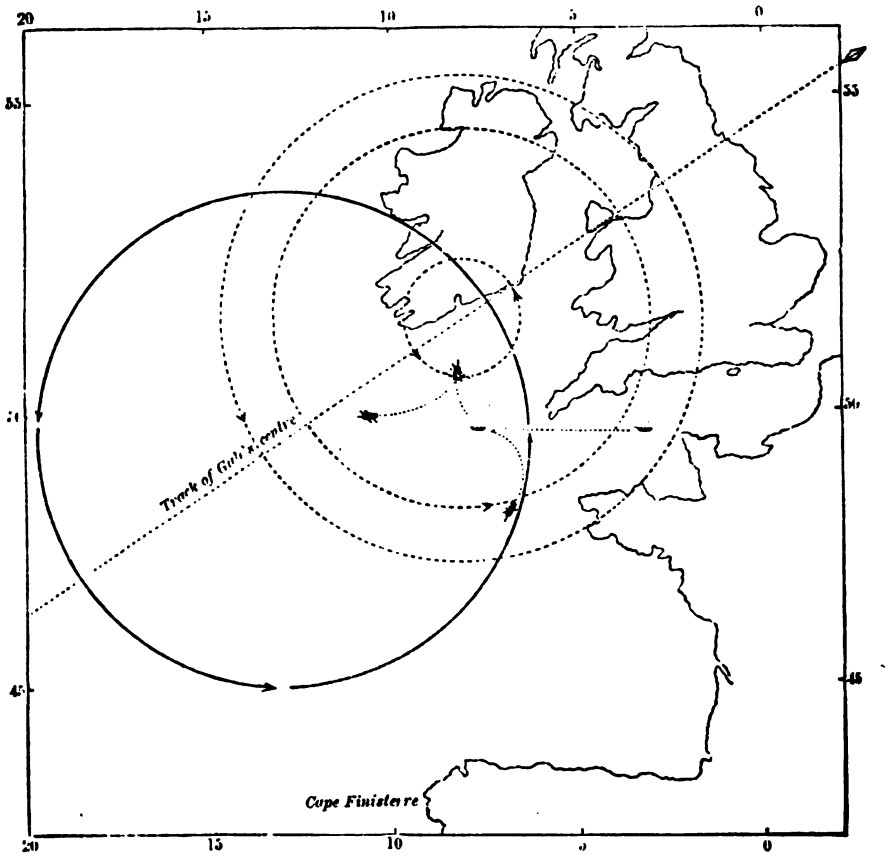
Gale of 6th Jan. 1839.

The next figure represents a supposed storm coming from the south-westward. The continuous circle is intended to show the gale setting in, with the wind S.E. at Liverpool. The dotted circle shows the direction of the wind after it becomes westerly, in consequence of the gale's progressive movement to the N.E.

Ships leaving English ports in the winter season, with S.E. winds and a falling barometer, very seldom,



I apprehend, clear the land before they meet with westerly winds. The next figure is intended to show the consequences which follow, from a ship outside the Lizard being on one tack or the opposite, when meeting



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a gale moving on a N.E. progression, in that part of the whirlwind where the wind blows south. The dotted circles are intended to show the gale passing off to the N.E. By inspecting the figure, it will be evident that if the ship be put upon the port-tack she will approach the gale's centre, falling off as the S.W. wind veers to W.: she would have more boisterous weather than if she had stood upon the starboard-tack; but the wind would veer further round to the N., to the ship standing northerly, than if she had gone to the southward. Had she stood on the starboard-tack

she would have sailed further from the centre of the gale, and therefore have found more moderate weather, and the gale would probably leave a ship in this position, with the wind ending at W.

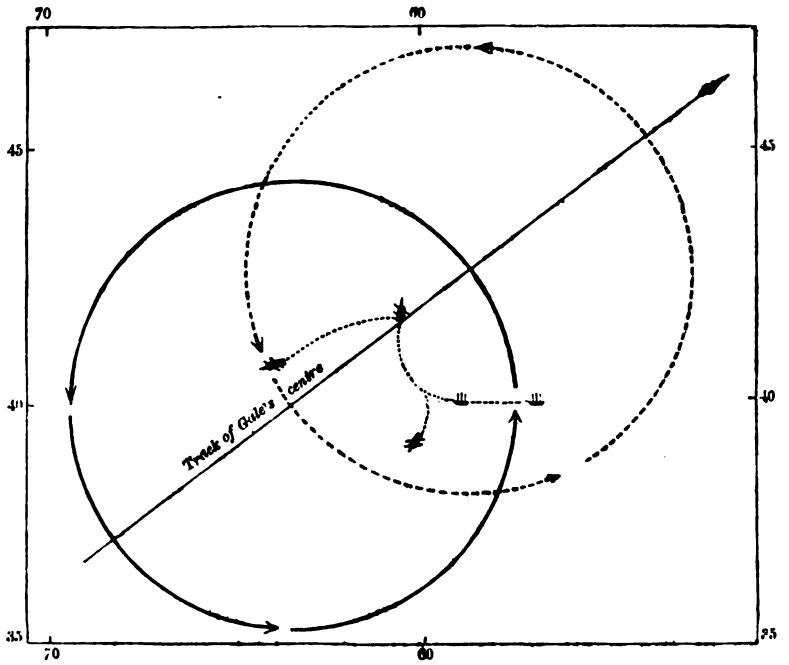
My endeavour here is, whilst explaining the manner in which the wind veers, to make a subject, which has been hitherto very obscure, more intelligible; and I leave it to seamen to judge whether, in practice, they can avail themselves of any of these explanations, either to shorten their voyages or to save lives and property.

No doubt, ships on leaving the English channel, and meeting gales at S. veering westerly, sometimes bear up and return to port just as the gale is about to veer to the north-westward, and to moderate.

All the investigations made into the nature of those gales of the north-western Atlantic, which cause the barometer to sink, prove that the wind revolves in circuits, with remarkable regularity, within the forty-fifth degree of latitude.

Nearly all the trade between Europe and North America passes between the Bermuda islands and Newfoundland, which is that part of the ocean where the variations in the wind have been best illustrated. Elaborate details, already published, prove that the gales marked on the general chart prefixed to the title-page, were all progressive whirlwinds, revolving by a fixed law, and causing variations in the wind which conform to that law.

When commanders of ships from Europe or the Mediterranean, bound to North America, meet gales blowing at south, between Bermuda and Newfoundland, they of course for a time stand on.



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By the above diagram, made to represent a gale moving towards the N.E., it will be seen how a ship sailing west, would fall off as the gale moves north-easterly. *If it should not blow too hard*, time may be saved in the voyage by keeping on the port-tack, even should a ship fall off towards N.; for, when the centre of the gale has passed to the eastward of the meridian of the ship, a north-westerly wind may be expected to follow. In the above figure, one ship is represented as having worn round from the port to the starboard-tack, and her head southerly. Being in the right-hand semicircle of a progressive whirlwind, that ship would come up to the wind as it veered; and, by going ahead, she would also draw away from the gale's centre: but she might expect to have the wind more

westerly than if she were in the position of the ship marked as on the port-tack.

But ships, under such circumstances, very often stand on too long on the port-tack, which no doubt has been the cause of some foundering. When reduced to shorten sail, and obliged to heave-to, it should be on the *starboard-tack.*

The following valuable observations on this point have been added to a recent edition of "Blunt's American Coast Pilot" (fifteenth edition, page *3):—

"*Heaving-to.*—The recent disasters which have occurred to American ships, such as the Dorchester, Medora, Ambassador, and many others, have caused some enquiry; and it has been suggested by experienced men, borne out by the facts, that the disasters may be traced to the 'heaving of ships to' on the wrong tack; that is, that vessels bound to the westward, from Europe, instead of 'heaving-to' with their *larboard-tacks on board* in a south-west gale, as is too often the case, should 'heave-to' on the *starboard-tack.*

"It is well known that our westerly gales, in the winter season, often begin at the S. or S.W., and, as they increase in intensity, haul round gradually, but sometimes suddenly in a squall, to the N.W. Take, then, the case of a ship bound to the westward, the wind commencing at the S. or S.W., the ship on the larboard-tack; the master, anxious to get to the westward, carries his canvas as long as possible, and continues on that tack until he has his ship under close-reefed topsails, mizen-staysail or trysail; in fact, 'hove-to' on the larboard-tack, the sea making heavy from the S.W., the wind keeps hauling to the westward, and the ship falls off with it until she lays in the

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trough of the sea. The sea, then, having the control over, and breaking with its full force on the broadside, there is no canvas at this time set that she can wear under with safety; the ship is then disabled, and sometimes founders. The fact is, over anxiety to get to the westward has kept the ship too long on this tack.

"Now, what is the best course, as a general rule, to be adopted? We think that the rule should be laid down that, when it is blowing so hard as to make it necessary to furl foresail or head-sails, previous to doing so the ship should be wore round, and 'hove-to' on the starboard-tack; and as the wind hauls, she comes up heading the sea more and more, until it is on the bow, and of course in the best position to avoid its shock.

"Again, often the wind shifts so suddenly in a S.W. gale, that a ship is taken aback by being on the larboard-tack, which is fearful at any time, and particularly at such a time. Those who have experienced it on a winter's passage from Europe, with a crew worked down with hard weather, and on a dark night, can only imagine what a scene it is.

"This cannot occur on being 'hove-to' on the starboard-tack."

By considering which way the wind is most likely to veer in these revolving gales, and by taking advantages of their changes, the voyage between Europe and North America may be shortened. On the contrary, if the veering of the wind be not observed, a ship may get into a succession of gales on that side of them in which the wind blows foul, and make a protracted voyage.

From Hallifax to Bermuda.

Ships from Halifax, sailing southward, as well as ships from Europe, may sail into gales on that side in

which the wind blows southerly; and if they fall into that quadrant in which the wind blows south-easterly, they would be, most probably, on the port-tack. Should the S.E. wind veer to S. and S.W., ships continuing on the port-tack would fall off, and their heads would, by degrees, come to point to the track of the gale's centre. Their position would be similar to that of a ship which had come from the eastward, and the last figure will serve to illustrate this case also.

Vesuvius.

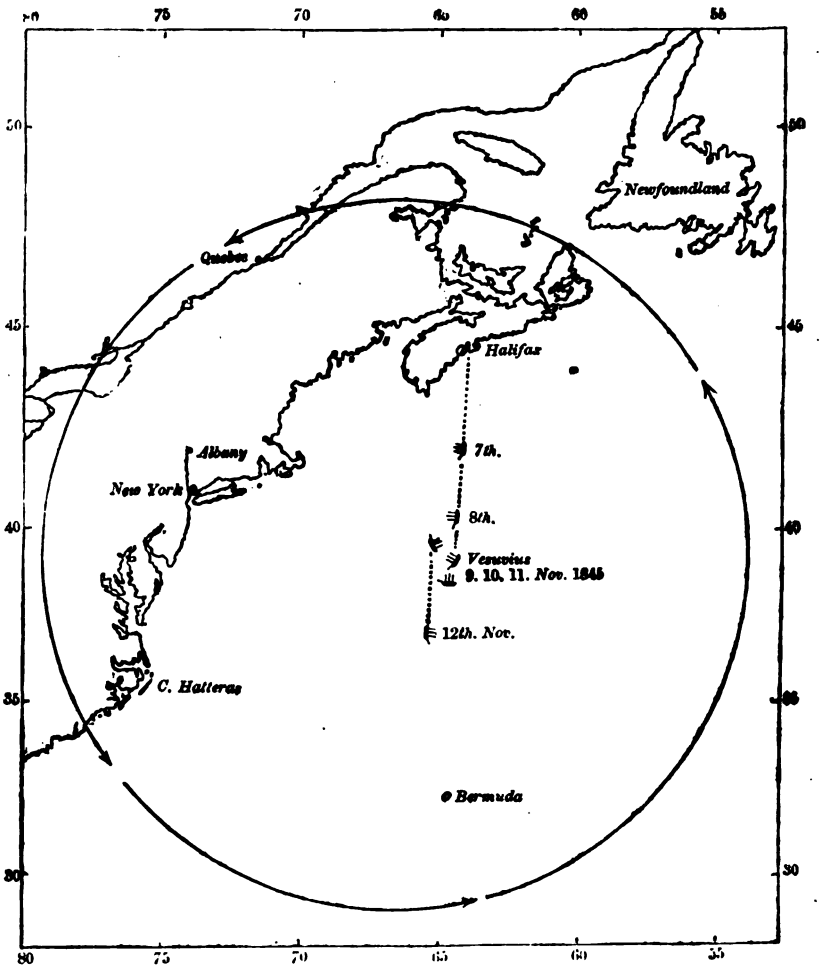
A practical example of this occurred to three British ships of war.

H. M. ship Vindictive, with the flag of Vice-Admiral Sir Francis Austen, left Halifax for Bermuda on the 6th of November, 1845, accompanied by H. M. ships Rose and Vesuvius steamer. The wind was easterly, veering next day to north in a moderate gale.

At 4 P.M. on the 8th it was calm, and the barometer began to fall. The new breeze which sprung up was south-easterly. Before midnight, the wind freshening was S.S.E., and the barometer down to 29·84. In the night the other ships lost sight of the Admiral.

On the 9th the gale increased, and the wind veering by the S. to S.W., the commander of the Rose, Captain Pelly, then wore his ship, and made sail to the eastward, knowing that this movement would carry him out of the gale. The flag-ship also wore at 1.20 A.M. on the 10th, when the wind had veered to S.S.W., and its force was marked 10. At noon, on the same day, the wind with the flag-ship was W. by S., and its force marked 11; the barometer standing at 29·36.

The Vesuvius (being under sail, without steam) continued on the port-tack, falling off as the wind veered



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round, and drawing nearer to the path of the gale's centre, until 11 A.M. on the 11th of November. Owing to the north-easterly progression of the gale, the wind by that time had abated and its force is marked 8. An extract from the log-book is given, as an interesting example of the danger ships may be exposed to by keeping too long on the port-tack in a gale in the

northern hemisphere. The Vesuvius lost her bowsprit, and was otherwise damaged.

This is an example of the November gales, such as are often met with between Bermuda and Newfoundland, and which tend to develop the nature of the Variable Winds. The following is an extract from the Bermuda register of the weather for one oscillation of the barometer :—

Bermuda register.

Date.	Hour.	Wind.	Force.	Weather.	Bar.	Ther.
Nov. 9	10 A.M.	S S W	3	b	29·99	74
	Noon	S	5	b c	29·92	78
10	9 A.M.	W N W	6	c m p q	29·91	69
	Noon	N W by N	4	b c q	29·94	70
	9 A.M.	S W by S	2	c m	30·13	68
	Noon	N W	1	c	30·15	70

Extract from the Log of H. M. Steam Sloop VESUVIUS.

Vesuvius.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Remarks.
1							Thursday, Nov. 6, 1845.
2	..	..	Fast to the				A. M. 8, crossed topgallant-yards.
3			buoy.				9, mustered at quarters.
4	..	..	.....	.....	0	b c	10, slipped from the
5							buoy, and made all plain
6	..	..	.....	.....	1		sail in company with
7							H. M. ship Rose.
8	..	..	West	West	2		10.30, H. M. ship Vin-
9							dictive passed.
10	..	..	Standing				11, a small schooner, on
			out of				port-tack, ran foul of
			Halifax.	.....	3		ship, and tore away part
11							of port bulwark, and stove
12	..	..	.....	W S W	5		second cutter.
							Noon, Vindictive and
							and Rose ahead 1½ mile.

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
				Chebucto Head, S.W. by W., 4 miles.

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Extracts from the Log of H. M. Steam Sloop VESUVIUS—*continued.*

H.	K.	F.	Courses.	Wind.	Force	Weather.	Remarks.
							Nov. 6—*continued.*
1	4	..	S by W	W by S	4	o u	P.M. 1.30, Sambro
2	4	6	S by W ½ W	West	..	b c	lighthouse W. by N. 6
3	4	..	.....	.....	5		miles.
4	4	2					4, Vindictive and Rose
5	3	4					in company.
6	3	4					8, Vindictive and Rose
7	3	..	S S W				in company.
8	3	..	.....	.....	3		12, Vindictive S.S.E. 2
9	2	6					miles; Rose ahead.
10	2	6	S by E				
11	2	5	S E by S ½ S	S S W			
12	1	6	S E ½ S				
							Friday, Nov. 7.
1	..	..	Head o				A.M. 2, braced round
2							to a light breeze from the
3	1	4	South	E S E	2	c r	westward.
4	2	..	S W by S	S E	3		3, Vindictive fired a
5	5						gun; lost sight of her
6	5						bearing E.
7	5	4	.....	.....	4	q r	9.45, carried away 3rd
8	8						port main-shroud.
9	8						10.30, unbent mainsail;
10	8	..	.....	East	6	m a	bent main-trysail.
11	8						Noon.
12	7						

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
S 2 W	90	D.R. 42°.6′	D.R. 63°.38′ W	Wreck Hill, Bermuda, S.5W., 641 miles.

1	7	..	S W by S	East	7	c o r	P.M. 1, squared yards;
2	7						down jib.
3	7						2, out main trysail.
4	7	..	.....	N E	6		6.15, set main-topsail.
5	7	2					10.45, set fore-topmast
6	7	2	.....	.....	..	c r	studding-sail.
7	7						12, set jib.
8	7						Midnight.
9	7	2					
10	7						
11	7	5	.....	N N E	5	c	
12	7	6	.....	North			
							Saturday, Nov. 8.
1	5	4	S W by S	N N W	4	b c	A.M. 2, set starboard
2	5						studding-sails.
3	5						10.15, squared yards
4	5						in gaff-topsail.
5	4						Employed cleaning ship.
6	3	5					
7	3	2	.....	N W	3		
8	3						

A moderate gale setting in.

Moderate gale ending.

Extracts from the Log of H. M. Steam Sloop VESUVIUS—*continued.* CHAP. XIV.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Remarks.	
							Nov. 8—*continued.*	
9	1	4					Noon.	
10	1	4						
11	1	..	.....	.....	1			
12	..	..	Hd.S W to S	.....	0			

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
S 11 W	123	Obs.40°.33′ D.R.40°.52′	Chro. 64°.11′ D. R. 64°.10′	Wreck Hill, S. 3°. 14′ W., 499 miles.

1	..	..	Head S W	.....	0		P.M. 1, in studding-sails and trimmed; set gaff-topsail.	New gale.
2	1	4	S W	S S E	2	b c		
3	2	..	S W ½ W				6.30, carried away gaff-topsail-yards.	
4	2	4	S W by W					
5	4	..	.....	by E	3		8.55, in topgallant-sail.	
6	3	6					Lat. by Polaris, 40°.14′ N.	
7	3	6	S W ½ S					
8	4						11, tacked.	
9	4	2	S W by S	S E by E	4			
10	4	2	S W	S S E				
11	4	..	W by S					
12	3	2	S S E	S W				Tacked;
							Sunday, Nov. 9.	
1	4	..	S S E	S W			P.M. 2.10, Lat. by Rigel, 39°.19′.	
2	3	5	S by E	.....	5	b c		
3	3	5	S S E				3.40, Lat. by Leonis, 39°.11′.	
4	4	..	S E ½ S					
5	5	2					7.30, close-reefed fore-topsail.	but again wore.
6	5	..	S E	.....	6	q		
7	4	6					8, wore; down topgallant-yards.	
8	4	4	E S E	.....	7	q r		
9	1	..	W S W				9, furled fore-topsail.	
10	1	4	W by S	S by W	..	c o	Noon.	
11	2	2	West					
12	2	4	.....	S S W		b c		

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
S	52	Obs.39°.20′ D.R.39°.41′	Chro. 64°.16′ D. R. 64°.11′ W.	Wreck Hill, S. 3°. 43′ W., 426 miles.

1	2	4	W by S	S by W			P.M. 1.40, carried away 2nd port main-shroud; got runner up to secure the mast.	Ship falling off.
2	1	6	.....	.....	7	c o		
3	1	4						
4	1	4						
5	1	..	W S W	.....	..	c r	4.30, struck main-topmast.	
6	1	..	West					
7	1						7, down main-topsail-yard.	See figure, page 360.
8	1	..	W by S					
9	..	..	Head from W N W to N W	.....	8	c q		

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Extracts from the Log of H. M. Steam Sloop VESUVIUS—*continued.*

H.	K.	F.	Courses.	Wind.	Force	Weather.	Remarks.
							Nov. 9—*continued.*
10	..	..	.....	.....	..	o	11, sea struck foremast
11							sponsor, knocked up deck
12	..	..	.....	.....	..	r l	of gallery, rendering them useless.
1							
2	..	..	Head from	.....		c q	Monday, Nov. 10.
3	..	..	W N W	.....		r	A.M. 12.30, carried away main-trysail-sheet; rove
4	..	..	to N W	S S W	8	l	new one.
5							3, carried away cringle
6							of fore-staysail; down do.
7							8.30, furled foresail.
8							10, in second reefs of
9	..	..	W N W to	.....	9	g o	gaff-topsail.
10	..	..	N W by N	S Westerly			11, in one reef of main-
11							trysail.
12	..	..	.....	.....	1	q	

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
N 67 W.	26	D.R.39°.30′	D. R. 64°.46′ W.	Wreck Hill, S. 24 W., 435 miles.

On port-tack, and still falling off.

1	..	..	.....	W S W	10	c o	P.M. 1.40, a heavy sea
2	..	..	Hd. N N W				struck the vessel, and
3	..	..	to	.....		q r	washed bowsprit, jib-
4			N W				boom, dolphin striker,
5	..	..	.....	.....	9		both jibs, and all the gear
6							away; employed cutting
7	..	..	Head from				wreck from bows; could
8			N W by N				not clear wreck of bow-
9			to	.....	..	o q	sprit in consequence of
10	..	..	N by W	Westerly			shackle not rendering,
11	..	..	.....	.....	..	c o	through chock on stem.
12	..	..	.....	.....	8		3, a sea struck the

port-quarter-boat, unshipped foremost davit; got the boat on board; stove bulwark in several places, washed away deck abaft starboard, sponsor washed up, cistern washed away.

3.30, carried away after-port main-shroud; employed securing main-mast with hawser; pumping water out of boilers; lost from cutter—oars boat, 8 in No.; mast, 2 in No.; boat-hook and stave, 2 in No.; yard, 2 in No.; bumkin, 1 in No.; awning stanchion, 2 in No.

Midnight.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Remarks.
1							Tuesday, Nov. 11.
2	..	..	Hd. N N W	Westerly	8	b c	A.M. Daylight, found
3			to	.....	..	q	deck washed up abaft
4	..	..	North	.....	..	r	port, after sponsor, and
5							lost ensign, ship, 1 in No.,
6	..	..	.....	.....	7	b c	pendants, mast-head, 2

Extracts from the Log of H. M. Steam Sloop VESUVIUS—*continued.* CHAP. XIV.

H.	K.	F.	Courses.	Wind.	Force	Weather.	Remarks.
							Nov. 11—*continued.*
7	..	..	Head N W				in No., bags, seamen, 1 in
8			to	.....	8	c o r	No.
9	..	..	North				8.40, succeeded in clear-
10	..	..	.....	.....	7		ing away wreck of bow-
11	..	..	.....	.....	8		sprit.
12	1	..	S by W	.....	7	c o	11, wore.

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
N 10 W	22	Obs. 39°.49′ D.R. 39°.51′	Chro. 65°. 9′ D. R. 64°.51′ W.	Wreck Hill, S. 1°.55′ E, 454 miles.

1	3	..	S by W	W N W	6	b c	P. M. 1.30, Hove-to.
2							2, bent fore-trysail, and
3	..	..	Hove-to				lighted fires.
4	1	4					4, steam up, and pro-
5	6	..	.....	.....	5		ceeded.
6	7						6.30, down fore-topsail-
7	7						yard.
8	7	4					
9	7	6	S by W ½ W	.....	4		
10	8	2					
11	8	6					
12	8	6	West	.....	2		
							Wednesday, Nov. 12.
1	8	4	S by W ½ W	West	2	b c	A.M. 12.40, furled main-
2	8	4					trysail.
3	8	..	.....	South	..	a	3.30, Lat. by Sirius,
4	8						38°.29′ N.
5	8						Employed unbending
6	8	..	.....	.....	4		sails and refitting main-
7	8						rigging.
8	8						
9	7	..	.....	.....	5	c a	
10	8						
11	6	2	.....	S W	6	b c	
12	6						

Course.	Distance.	Latitude.	Longitude.	Bearings and Distance.
S 10 W	152	Obs. 37°.41′ D.R. 37°.20′	Chro. 65°.25′ D. R. 65°.18 W.	Wreck Hill, S. 5 E., 327 miles.

1	6	..	S by W	W S W	7	b c	P. M. Watch employed
2	5	6					getting down main-top-
3	6	4	.....	.....	..	c q	mast rigging.
4	6	4					2, set fore-trysail and
5	6	6	South	S W by W	..	r	staysail.

Wore, and lighted fires.

CHAP. XIV.

Extracts from the Log of H. M. Steam Sloop VESUVIUS—*concluded.*

H.	K.	F.	Courses.	Wind.	Force	Weather.	Remarks.
							Nov. 12—*continued.*
6	8						4. 30, set main-trysail.
7	8	5	S by W	.....	5	r	Midnight.
8	8	5	.....	.....	6		
9	8	4					
10	8	6	.....	.....	..	c o	
11	8	4	.....	.....	..	r	
12	9	2	.....	.....	5		

I obtained from Mr. Redfield an extract from his Register, of the weather at New York for the 8th, 9th, and 10th of November, 1845, at the time when the British ships of war were in this gale, and I here give that extract. I learned that at the same time, it blew so hard at Albany, in the state of New York, that chimneys and fences, as well as a new Penitentiary which was erecting, were blown down, and that the storm was felt as far as Quebec. The diagram at page 350 will show the extent of this November gale; and serve as another example of the extended space which some of the winter gales embrace.

Extract from the Register of the Weather kept at New York, by W. C. REDFIELD, ESQ.

Date.	Hour.	Bar.	Wind.	Force.	Remarks.
1845.					
Nov. 8	A.M. 6	29·90	W to E	2	
,,	,, 10	29·88	E	4	
,,	P.M. 2	29·80	E by N	4 to 6	
,,	,, 6	29·67	,,	6	
,,	,, 10	29·59	,,	6	
9	A.M. 6	29·50	N W by N	4	
,,	,, 10	29·50	N W	2	
,,	P.M. 2	29·41	,,	2 to 4	
,,	,, 6	29·40	N N W	4 to 6	
,,	,, 10	29·42	,,	6 to 8	Fresh gale.
10	A.M. 6	29·52	N W to W N W	8 or 9	Gale.
,,	,, 10	29·64	N W by W	,,	,,
,,	P.M. 2	29·74	,,	,,	,,
,,	,, 6	29·84	,,	6 to 2	
,,	,, 10	29·92	,,	2	

"N.B. The hardest part of the gale having passed over New York during the night time, its greatest force is probably not recorded here."

Sailing from Europe to America.

Most of the North Atlantic gales seem to have a north-easterly progression. When ships from Europe bound to America fall into the northern half of these gales, they will have the wind at east and fair for their voyage. If the weather should not be threatening, or the barometer fall rapidly, they should no doubt stand on their course.

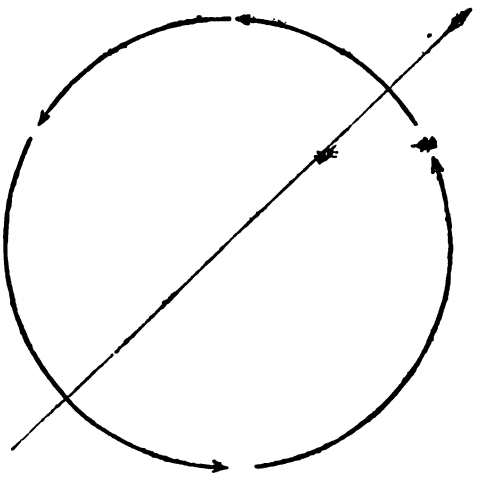
The appearances of the weather, and indications of the barometer, and also of the swell of the sea, may be such as may make it very difficult for a commander to know what course is best to decide upon; thus, on the 22nd August, 1837, the barque Barlow, in her voyage from England to St. John's, New Brunswick, stood on in a gale at S.E., and obtained a fair wind by doing so; passing a ship hove-to, supposed to be the Mediator, bound for New York.

In this instance the Mediator might with advantage have run on like the Barlow.

See Law of Storms, 2nd edit. page 109.

There may be danger in heaving-to in the North Atlantic, with the wind at S.E. and a rapidly falling barometer, lest the gale should be moving N.E. In that case it would be waiting for the hardest part of the gale to pass over the ship, as indicated by the figure on the next page.

On the contrary, the fate of the barque Carmelita, in the North Atlantic, is an instance of the risk incurred by scudding in front of a progressive whirlwind, for the sake of profiting by the east wind of the front half of the storm; and it is of the greatest importance to discriminate between scudding in the front half, or hinder half, of a progressive whirlwind.



The Carmelita sailed from Fayal for Boston, on the 9th of September, 1848, and had light baffling winds, until the afternoon of the 18th. After that day the Carmelita began to feel the east wind of that same storm, which caused some degree of alarm at Barbados on the 19th September. By the 23rd the wind had increased so as to have become a hurricane. The vessel was scudding towards Boston, and the first misfortune which befel her was carrying away the mainyard. From that time began the difficulties and perils, incident to a ship in front of an advancing whirlwind tempest. Many of the crew and passengers were drowned, and the ship only kept afloat, from the circumstance of her cargo being oil and wine. The survivors were taken off the wreck by the barque Castries, of St. Lucia; and a detailed narrative of what befel that ship is published in the St. Lucia *Palladium* newspaper, from the log-book of the Castries.

Along with a letter published in the *Nautical Magazine*, for May, 1849, the commander of a ship called

the "Sea," Mr. Freeman, transmitted a copy of his log-book to the editor, under an impression that the wind at the place of his ship, on the 21st and 22nd of February, 1847, hauled contrary to the theory of storms: he adds, that he was much surprised at the time, because it was a solitary case contrary to all his experience.

I shall reprint the extract alluded to, and endeavour to show how the apparent contradiction to the theory disappears, when we divide the register of the weather, according to the oscillations of the barometer. It is then seen, that the barometer had been rising with a westerly wind on the morning of 21st of February, but after 8 o'clock it again began to fall, and the wind came from the *south-eastward*. A new rotation of the wind, blowing at first lightly, was setting in. During the next twelve hours the barometer fell more than an inch; the wind increased as the barometer descended, and at 2.33 P.M. it blew a hard gale from south-east. At 7.50, when the barometer was lowest, the wind subsided, the waves appeared subdued, and the sea a sheet of foam, with that temporary brightness overhead, which the Spaniards expressively call "the storm's eye." These indications would seem to point out that the ship was then very near the centre of a rotation of wind.

After this period the barometer began to rise, and continued rising for seventeen hours, and then again it began to fall, whilst the wind, blowing lightly, veered to W.N.W

CHAP. XIV.

Extract from the Log-book of the SEA, *from Liverpool to New York, in February,* 1847.

H.	K.	F.	Courses.	Wind.	Bar.	Remarks.
						Sunday 21st.
1	1	4	up N W by W off N by W	W by S and W S W	29·42	A.M. Hard gales, but moderating a little, and rather less sea on; ship under close-reefed fore and main topsail. At 3, set mizen-topsail, and single-reefed fore course; 6, let the close-reef out of the fore and main topsails, set reefed main course and reefed spanker. 8, light winds and thick hazy weather, with rain; heavy sea on from the westward; *let the second reefs* out of the topsails, *reef out of courses* and spanker; set jib and top-gallant-sails. 10.30, furled jib, close-reefed main-topsail; 11.30, in fore and mizen topgallant-sails; noon, strong breeze and thick weather with rain, and heavy
1	1	4				
2	1	4				
3	1	4				
4	1	4	N W		29·47	
5	2			S W		
6	2					
7	2					
				to		
8	2				29·47	
9	2		W N W			
10	2		W by N	S E		
11	5			E S E	29·30	
12	6				29·17	
1	8				28·93	
2	8		W		28·75	
3	8	4		S E	28·60	
4	8	4		S S E	28·55	
5	6			S by E	28·47	
6	6				28·35	
7	4	4			*28·18	
8	4	4	W N W		*28·18	
9	3	4	N	W	28·20	
10	3	4			28·50	
11	2		N by W		28·71	
12	2				28·75	

New gale setting in.

westerly sea on. Lat. Acc. 52°.18′ N., Long. 30°.33′ W.

P.M. Strong gale and thick weather with rain, close-reefed the fore and main topsails, furled the mainsails, in first reef of the foresail and furled it; 2.33, blowing a hard gale from S.E., furled the main-topsail; 4, hard gale and thick weather with continual heavy rain, the westerly sea nearly all knocked down, and the southerly sea making fast; 6, more moderate, heavy sea from S.E. and raining very heavy; 7.30, I kept off W.N.W., the wind being now quite moderate and the sea very dangerous; she went along beautifully, but though she shipped no sea, she would roll her weather rail nearly under at times.

Storm's eye.

At 7.50, it had cleared off and ceased raining; and *I observed it began to lift up quite bright* to the westward, clued the fore-topsail up at once, but before the men got aloft it had burst out, not a gale, but a young hurricane, and they could not furl the sail. It was well we had leech lines round the sail else we should have lost it altogether. The main yards were not braced up sharper than about eight points, but I durst not start anything now; I expected the yards would go every minute though they were well secured with preventer braces. *The sea appeared to be knocked down greatly, and all in a sheet of foam.* I endeavoured to look to windward, but I could not see; the howling of the wind was terrible. At 9, the barometer had risen a little; at 11, the fury of the storm was spent, and we got the fore-topsail made fast. Midnight, violent storm and high sea.

See pages 115, 118.

H.	K.	F.	Courses.	Wind.	Bar.	Remarks, &c.
						Monday 22nd.
1	2			S W by W	28·80	A.M. Violent gale and sea running very heavy, but the ship rides nobly. I am surprised at the wind
2	2		up N W			
3	2		off N W by W			
4	2				29·00	

Bar. rising, and weather

Extract from the Log-book of the SEA—*concluded.*

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H.	K.	F.	Courses.	Winds.	Bar.	Remarks.	
						Monday 22nd—*continued.*	
5	1	4	up N W by W	W S W		hauling to the S.W. again;	mode-
6		4	off			I expected it would have	rating at
7	1	4				gone to W.N.W. or N.W.,	4 A.M.
8	1	4	N N W		29·10	and I am glad now I had	
9	1	4	up W N W	S W by S		not time to wear ship. At	
10	1	4				4, it had moderated greatly,	
11	1	4	off N W by W			and there was much less	
12	1	4			29·14	sea.	
						At 8, quite moderate,	
1	1	4	N W by W	S W	29·15	but the weather looks very	
						unsettled, and the baro-	Bar.
2	1	4				meter keeps low; set close-	falling
3	2		N W by N			reefed fore and mizen top-	again,
4	2				29·10	sail, single-reefed foresail,	
5	2		N by W	W		and reefed spanker, in-	
6	2					spected the mainyards and	
7	2	4	N ½ W	to		found them all right; tried	
8	2	4			29·05	the pumps, but find the	
9	3		N by E	W N W	29·03	ship has not made a spell	
10	2					of water the twenty-four	
11	2		N N E		28·95	hours.	and
12	2				28·95	Noon, moderate breeze	

and cloudy weather, and sickly haze over the sun. Latitude Observed 52°.23′ N., Long. Chron. 32°.08′ W.; Lat. Acc. 52°.26′ N., Long. Acc. 31°.43′ W.

P.M. Light winds and cloudy weather, the sun covered with a thick dirty haze; 1, let the close-reef out fore and aft; set reefed mainsail and jib; 3, the clouds began to gather very heavy in the westward, and strong flaws would strike us frequently; in jib and mainsail, and close-reefed the top-sails.

At 6, moderate breeze and clear weather to the westward, *but thick heavy clouds in the* S.E. *quarter; much less sea on.* Through the first watch moderate winds and clear weather for the most part, *at times it looked very threatening,* the Aurora Borealis shining beautifully. — weather threatening.

The following extract from Captain Freeman's letter is well deserving of being read by seamen:—"I suppose no person will dispute with me, when I say that, even if the theory of the authors of the Law of Storms cannot always be made available to avoid it, it is positively necessary to know correctly which side of the storm we are on, and how the centre of it bears from the ship, and the general track of the storms in the quarter we are then navigating. I prize the works for these points of themselves, beyond this I am not yet convinced at present the theory can be of much use in the North Atlantic. I believe these storms are so extensive in

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general that they cannot be avoided, when bound westward at any rate, and I do not assert this without some reasons for so doing. I shall enclose you a copy of my own private log for the 17th December, 1848, showing the position of my ship that day, and also send you an extract I copied from a New York paper after I arrived there, which will, I think, convince you, that had I had a steamer instead of a sailing ship I could not have avoided the fury of that storm.

See Chart, opposite to page 328.

"The ship Caleb Grimshaw, which sailed from Liverpool in company with me, was 120 miles to the southward, and within ten or fifteen miles to the westward of me at noon that day, and his barometer stood at 28·10; we compared logs after we both arrived at New York, and they appear to have had it as heavy as we had, according to the relation Captain Hoxie gave me, though his barometer was not so low as either mine or the Cambria's (Cunard steamer), which vessel appears to have been in 51° N., 150′ south of the Caleb Grimshaw. Mr. Piddington says, 'It is very uncertain what are the sizes of hurricanes hereabouts, most seamen will prefer heaving-to, and allowing the centre to pass them.' Now in point of ascertaining the extent of hurricanes in the Atlantic, that must rest with seamen, and it might soon be decided if they would only give the subject that attention it deserves, and communicate their observations. Many perhaps feel a backwardness in writing anything that will appear before the public, for various reasons, and one no doubt often is that they feel conscious they have no great ability. To be plain, they do not in many instances feel competent to pen their thoughts in a way satisfactory even to themselves. Neither can I. But if any man chooses to ridicule my want of learning or

See Chart opposite to page 323.

ability, let him do so. My only answer is, had he been situated as I have (at sea since I was twelve years of age), perhaps he would not have been a greater proficient in learning than myself; therefore, I shall not refrain because I am not talented, and I hope I shall be careful not be presumptuous, or dogmatical, when showing my opinion.

"As regards heaving-to, allowing the centre to pass over them. Bound to New York, the principal chances of getting to the westward are with south and south-west winds, with a few hours of south-easter occasionally. I speak now of the stormy part of the year, and as a general rule I can see no advantage to be derived from heaving-to. Put the ship's head which way you please, the wind at south, we will suppose as the wind was with us on the 17th December, the storm then bears due west by compass, and is travelling, I presume, in about an east-north-east direction per compass, and coming right down on the ship. I think it can very rarely happen that you can cross the path of the hurricane in port until you bring the barometer to rise, and the wind hauling to the east-north-east. It in general blows so heavy that close-reefed topsails and reefed foresail is as much canvass as a ship can bear, and as much as can be handled; and it would never do to drag on to the last minute, blowing so very heavy, with such plain indications of a severe storm approaching, and probably be caught and not have time to get it in. I have heard some men say they never close-reefed their topsails. I have seen considerable difficulty to take a close-reefed topsail in with plenty of men, and good spilling lines round the sail; and if they are not taken in, they will take themselves wings and fly away. Nor does Mr. Piddington advise this."

See diagrams at pages 344, 347.

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It is much to be desired that practical seamen should thus contribute information, and express their opinions as Captain Freeman has done. The next extract, from another of Captain Freeman's log-books, affords an interesting example of the winter gales encountered by ships *sailing westward.*

Extract from the Log-book of the MARMION, *from Liverpool to New York, for December,* 1848.

Marmion.

H.	K.	F.	Courses.	Wind.	Bar.	Remarks.
						Saturday, 16th.
1	5		S	W by N to	29·38	A.M. From 1 to 4, strong
2	6			S W by W		gales and squally, the wind
3	6		S ½ E		29·36	veering three or four points
4	6				29·34	very often in the squalls,
5	5		S by E ¾ E			with hail and snow. At
6	5		S S E / N W	Baffling	29·32	5, blowing strong and very angry aspect to the west-
7	4		N by W			ward. Close-reefed the
8	5		N by W ¾ W	W and		topsails, reefed the courses,
9	4			W by S	29·32	and furled the mainsail, and
10	4					at 6.30 wore ship to the
11	4				29·30	N.W., and set the fore
12	4					course and main-trysail and main-top-staysail, but
1	3		N by E			we had not been round
2	3	4				long before the wind
3	3	4	N N E ½ E			headed us off to N. by W.
4	3				29·33	At 8, strong gales, and
5	4		N N E			the *wind very unsteady.*
6	5					Through the forenoon
7	5		N ½ W	W by N	29·35	watch strong winds and
8	5					squally unsettled weather
				to		with much hail snd snow,
9	5		N W	S W by W	29·35	*but it does not blow near*
10	5			and	29·29	*as hard as it did* before
11	6		W N W	S W by S	29·22	daylight. Lat. 54°.40′ N.,
12	8			S	29·11	Long. 20°.00′ W.

Bar. falling.

P.M. From noon to 4 it was *quite moderate and very baffling;* sometimes it would head the ship off to N.E.; twice I prepared to wear ship and she came up to north again. Ship under close-reefed topsails, and reefed courses and spanker. At 4, *let the reef out of the courses* and set the jib. *I do not like to be under this short sail, for there is not much wind now, but the barometer has been ranging between* 29·40 *to* 28·53 *the last four days, and I feel confident we shall have it blow heavy yet.* Last February it was just the same for five days, and blew violently at last, though we had not much wind to speak of all the time previous, only for a few hours. At 8, moderate wind and fine weather, the stars all shining bright and beautiful. Let the close-reef out of the main and mizen topsail, but kept the close-reef in the fore-topsail, for I felt well aware we should have a storm soon. At 8.30 the wind began to haul to the S.W., the weather too *became damp* and hazy, and the barometer *a little falling.* Midnight, blowing a common gale and increasing rapidly, raining a little, *heavy swell* from the S.W., ship pitching hard.

Extract from the Log-book of the MARMION—*continued.*

H.	K.	F.	Courses.	Winds.	Bar.	Time.	Remarks.
							Sunday 17th.
1	8		N W by W	S S E	29·04	1 0	A.M. Blowing
2	9		N N W		28·89	2 0	heavy. In spanker
3	9		N W by N	S	28·69	3 0	and main-topmast-
4	9		N W		28·50	4 0	staysail, and hauled
5	8			I find this is lowest my bar. has ever been in four years.	28·40	4 45	the mainsail up, kept
6	8				28·20	6 15	her off to get the jib
7	8				28·11	6 45	in, and kept her run-
8	7				28·03	7 45	ning off until we got
9	5				27·99	9 0	the courses furled,
10	5			S by W	27·75	10 0	and close-reefed the
11	4		N by W	to	*27·70	11 45	main-topsail and
12	1		S off S by E	W by S	*27·70	12 0	furled the mizen-top-
							sail.
1	1	4	up S by W ½ W	W	*27·70	1 0	At 2, it was blow-
2	1	4			27·75	2 0	ing very hard, hauled
3	1	4	to		27·95	2 50	to the south, and
4	1	4	off S ½ W		28·70	4 0	the sea running
5	1		up S S W		28·20	5 0	heavy, from the
6	1				28·38	6 0	southward now.
7	1		to				Ship under close-
8	1		off S		28·50	8 0	reefed fore and main
9	1		up S S W		28·55	9 0	topsail and fore-top-
10	1				28·60	10 0	mast staysail. Rove
11	1		off S		28·64	11 0	the back spilling
12	1				28·68	12 0	lines on the fore and

Swell from southward.

main topsail. From 4 to 8 it blew very heavy, and then it moderated very much; I took advantage of this, took in the fore-topsail and furled it snug. From 8.30 to 10.30 it blew hard, the sea running tremendously heavy, and several seas broke aboard but did no damage. At 10.30 it began to break away and the ship to cant to the S.W.; called all hands and wore ship immediately, and *the wind hauled so briskly* that by the time we had the yards trimmed she headed up south. Set the main-trysail, but did not haul the head more than three-quarters out. Ship jerking violently now she is right head up to this tremendous sea, broke one of the hooks of the relieving tackle blocks, and took full charge of the wheel herself for a minute, till we secured her. *At noon it was quite moderate, and a beautiful clear blue sky, and the sun shining beautifully, but this is the treacherous centre.* Lat. Observed 55°.32′ N., Long. deduced from Chronometer 22°.35′ W.

Wind veering fast.

Storm's eye.

P.M. From meridian to about 0.40 it remained quite moderate and clear, but not cloudless, the sun shining through the clouds as they passed along. At 0.40 *there rose up* a thick impervious cloud or haze, and *it became quite dark, comparatively speaking*, though there was no black cloud, and *in a very few minutes* we were involved in a terrific storm. I wished now that the main-topsail was in, but start it now I dared not! The fore-topmast-staysail sheet parted, and split the sail very much; the yards were well secured with a preventer brace on the topsail yard, and a good jumper under the weather side of the mainyard, but they buckled and twisted like a tree in the forest. About 2.30 one of the blocks on the bumpkin drew out of the iron strap on the weather side and came whizzing past my head within a hand's breadth, they say, and I thought now my yards were sold. Not so, however; the lee main-topsail-sheet parted and then the weather one; the main-topsail yard was bound to the topmast-head if it could have got there, but I had taken my usual precaution to have the reef tackles made fast. The lee clue lines got unhooked from the sail, the lee buntline and leechline parted, but all the weather gear held on, and we

Opposite side of storm coming.

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Extract from the Log-book of the MARMION—*continued.*

got the sail partially secured, and kept the yard well braced in, so that we saved the sail—very little hurt—a new sail in Liverpool. Hauled the head of the main-topsail down as low as we could, for the gaff cut a high caper. I found since the main-topsail is off she fell off considerably, so that she lay very much exposed to the sea, which was running exceedingly heavy, and I cut off a piece of the topmast-studding-sail, and got it in the weather mizen rigging, and then she lay very well; but the ship lay down sheer plank in all the time, and sometimes put her lee-rail under, and the masts shook about at such a rate I expected some of them would go. About 8, I thought it eased a little; and at 10, we got a fore-topmast staysail hoisted up with the throat halliards of the spanker. Midnight, heavy gales and tremendous sea.

H.	K.	F.	Courses.	Winds.	Bar.	Remarks.
						Monday 18th.
1	1		up S S W	W	28·72	A.M. From midnight to
2	1				28·80	4 it blew heavy, and the
3	1					sea ran very heavy, but
4	1		off S		28·84	it was moderating per-
5	1					ceptibly all the time: seven
6	1		up S S W		28·90	men laid up. At 7, set
7	1					the main-topmast staysail
8	1		off S		28·95	and whole spanker, and
9	1		up S S W			unbent the fore-topmast
10	1		off S ½ E		29·00	staysail. From 8 to 12,
11	1		up S W			moderate wind and squalls
			off S S W	W N W		at times; at intervals it
12	1		up W S W	to		was nearly calm with
			off S W by W	N W by W	29·00	some smart showers of
						hail and rain and black
1	1		up W S W			heavy clouds; the sea
2	1				29·10	keeps up very heavy, the
3	1					main rigging and back-
4	1		off S W		29·10	stays have stretched off
5	1	4	W S W		29·13	very much, and the ship
6	2					being laboursome, the
7	2		S W by W ½ W	N W and	29·19	masts slap about horribly.
8	2			N W by N	29·24	At 10, the wind veered
9	3				29·29	to the N.W., but there
10	3	4			29·35	was not much of it. Un-
11	3	4	S W	N W by W		bent the main-topsail, only
12	4		S W ½ S		29·35	one cloth is injured where

Moderating, and bar. rising.

the lee-sheet struck it, when it parted and split it from the close-reef down to the foot, about the breadth of ten inches. At noon Lat. Acc. 56°.03′ N., Long. Acc. 21°.27′ W.

N.B.—I have allowed her four points leeway, and 36 miles for heave of the sea, N. 53° E.; the variation is three points W.

P.M. Fresh breezes and cloudy weather with hail showers, and the sea *running heavy from* N.W. *now*, but *we have not had any wind from that point;* bending another main-topsail; 5, set the close-reefed main-topsail; 5.30, set the fore-topsail close-reefed; 6, sharp hail squalls, cormorants at each topgallant-masthead and yardarm; 7, set the reefed foresail; 8, fresh breezes and fine clear night, the stars shining beautifully; 9, set the reefed mainsail, and close-reefed mizen-topsail. Midnight, strong breeze and the sea as heavy as it was at noon.

Swell changing.

Extract from the Log-book of the MARMION—*concluded.* CHAP. XIV.

H.	K.	F.	Courses.	Wind.	Bar.	Remarks.
						Tuesday 19th.
1	4		S W	N W by W	29·35	A.M. Through the mid-
2	4				29·37	dle watch fresh breeze
3	3	4	S S W	W by N		and very high seas on, a
4	3	4				good deal of haze about
5	4		S			the moon; thick, cloudy
				to		weather for the most part;
6	4				29·34	5.30, wore ship to the
7	5		W by N ½ N	S W by S		W.N.W.
8	5					The wind began to in-
9	5		W by N	S S W	29·28	crease fast; 9, in mainsail,
10	4		W	S by W	29·24	mizen-topsail, and main-
11	2	}	up W		29·15	topmast staysail; 10, in
12	2	}	off W N W	S S W	*29·09	foresail and fore-topsail.
						Through the latter part
1	1	}	up W N W	S W	29·10	of the forenoon employed
2	1	}	off N W		29·12	swiftering the main-
3	1	}	up S S E			rigging and backstays in
4	1	}	off S E			until we got an oppor-
5	1	4				tunity to set them up. At
6	1	4			29·12	noon, hard gale and heavy
7	2	}	up S by E			rain, and high sea on.
8	2	}	off S E by S			Lat. Acct. 55°.19′. N.,
9	2	}	up S by W		29·12	Long. 21°.27′ W.
10	2	}	off S by E		29·18	P.M. 1.30, wore ship to
11	1	4			29·24	the S. S. E.; 4, strong
12	1	4			29·29	wind and quite bright and

clear in the N.W., except at the horizon, and there was a heavy bank of clouds rising; 6, it was blowing a strong gale and a high sea running. Midnight ends the same.

Bar. falling again.

On the 23rd I had a very severe gale from the south, the barometer fell from 29·50 to 28·64, and then I wore round on the starboard tack, and the wind must have followed me round almost as fast as I paid off. I had been heading W. by S. and laid right head up to a tremendous sea when I got round heading south. As a general rule, I would always, when on this side of the storm, wear round on the starboard tack the first moment it lulls, when it has been blowing hard from S. or S.W. *Too sharp a lookout cannot be kept in the winter time* especially in the North Atlantic *for the shift.*

See fig. page 346.

H.M. ship Rose.

H.M. ship Rose met a gale on her voyage from Halifax to Bermuda in August, 1843. Instead of meeting the wind at S.E., veering to S. and S.W., as did the Vindictive, Rose, and Vesuvius, in November, 1845, the Rose on this occasion fell into the gale's left side, in which the wind veers from N.E. to N. and N.W. When she hove-to, it was on the *starboard-tack*, therefore drawing from the gale's centre: but on that side of the gale's path, a ship on

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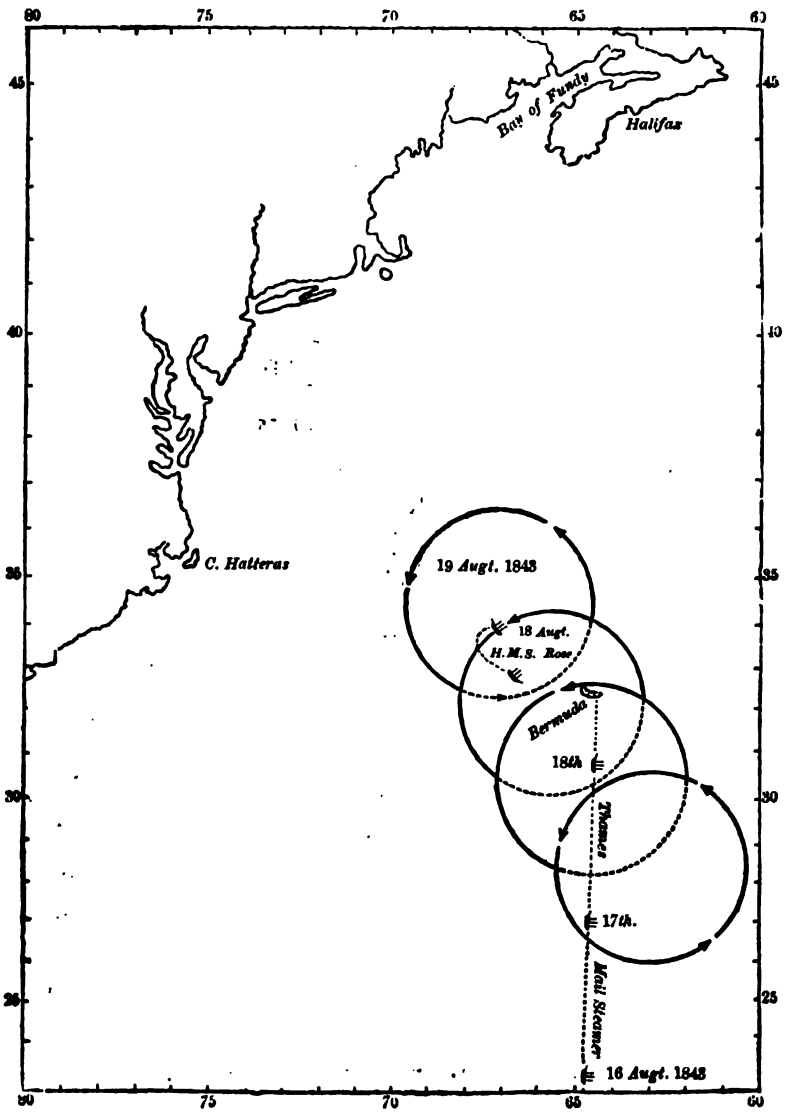
the starboard-tack would fall off; and the following extract from the Rose's log-book will show, that she fell off fourteen points of the compass, or about 158° of the circle.

Extract from the Log-book of H. M. Ship Rose.

Hour.	Course.	Wind.	Force.	Weather.	Bar.	Remarks.
						August 18, 1843.
A.M. 1	S W by W	S by E	4	b c	30·10	Moderate breeze and
6	S S W					cloudy. 6.15, up mainsail.
7	South	....	2			
8	S by E ½ E	E by N	3	b c	30·00	Swell rising from E.N.E.
12	....	....	5	..	29·90	quarter.
						Lat. by Obs. 34°. 09′ N.,
						Long. by Chron. 66°. 46′ W.
P.M. 1	S S E	E N E	5	c	..	5.15, close-reefed main
6	....	....	6	c d		and furled fore topsail.
7	....	....	8	c or g		
8	....	....	..	..	29·80	8, wore.
9	up N by	E N E	9			Midnight, ship laying-to
10	W	to	..	c or q g		under close-reefed main-
11	off		10			topsail and storm staysail;
12	N W	North	10	..	29·75	hard gale, with frequent heavy squalls and rain.
A.M. 1	N W	E N E to North	11	g q r	..	2.50, in main-topsail; at this period the gale was at
3	W by S	N by W				its height, and blew most
4	W S W	....	11	g q r	*29·65	violently in squalls, accom-
5	up S W					panied with heavy rain, and
6						an ugly threatening appear-
7						ance in every quarter.
8	off S S E	N W	..	..	29·70	
9	up S S W	West	8			
10						
11	off S S E	W S W				Lat. by Obs. 33°. 04′ N.,
12	....	....	6	..	29·75	Long. by Chron. 66°. 20′ W.
P.M. 1	S E	S W	5	c q		
8	S E ½	S W	4	o c	29·90	Midnight, moderate breezes
12	....	....	4	..	30·00	and cloudy.

I witnessed this gale when at Bermuda. As it there set in at E., or a little to the N. of E., and veered by the S.E. to S., moderating at S. by W., with the barometer, which had fallen to 29·61, again up above 30 inches, I felt no doubt at the time that it had come from the south-eastward, and this was soon

confirmed by the arrival of different vessels. As the gale was coming from the south-eastward, it was obliquely crossing the front of the track of the West India mail steamer Thames, from St. Thomas's, in the West Indies. The gale passed ahead of the steamer,



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which steamed into the south-western quarter of it, receiving the wind in consequence from N. by W., changing, as both gale and steamer moved on, to N.W., to W., and to W.S.W., blowing in hard squalls for a time; but the gale was travelling faster than the steamer, which arrived at Bermuda just as the gale left it, moving in an unusual direction towards N.N.W.

The preceding figure is intended to represent this gale passing over Bermuda. It curved in the direction of the Bay of Fundy, where it caused some damage.

Extract from the Weather Tables published at Bermuda, for October, 1843, during One Oscillation of the Barometer.

Date. 1843.	Hour.	Wind.	Force.	Weather.	Bar.	Ther.	Remarks.
Aug. 18	A.M. 6	E	6	c m	29·99	76	
,,	,, 9	E	6	c m r	29·99	80	
,,	,, 10	E N E	8	c m r	29·92	77	
,,	P.M. 1	E	9	c m r l	29·82	77	
,,	,, 2	E S E	10	c m r l	29·79	77	
,,	,, 4	S S E	10	..	*29·61	77	
,,	,, 5	S by E	11	..	*29·61	77	
,,	,, 6	S	11	c m r l	29·64	76	
,,	,, 9	S by W	11	o m r l	29·71	75	
19	A.M. 9	S by W	6	..	30·03	80	

An instance of the speed of a steamer being judiciously slackened to prevent her being plunged into the vortex of a storm, occurred in the case of the West India mail steamer Medway, commanded by Captain Andrews, in September, 1846. This packet was on her passage from Nassau in the Bahamas to Bermuda, at the time when a storm, coming from the southward, was passing between those two groups of islands. On the Bermuda side the gale veered by the south, whilst on the Bahama side it veered by the north. The Commander of the Medway, perfectly well understanding the

See track XIX. on the General Chart.

nature of the storm he was approaching, and knowing his position with relation to the storm's centre, took in his sails, struck his yards, slackened his rate of steaming, and hove-to, waiting for the wind, which was N.E., to veer to N.W., as he knew it would do. He then bore up; ran round the hindermost portion of the storm for Bermuda, and arrived there without sustaining any injury whatever, and gave me an account of what he had done.

Perhaps the commencement of no great storm has been better ascertained than this one. It formed on the 10th of September, 1846, between the islands of Trinidad, Marguerita, Grenada, and Tobago. The Royal mail steamer Tay, was lying at the time at Port of Spain, Trinidad. The barometer on board fell to 29·86, and much thunder and lightning was seen to the northward.

See General Chart, track XIX.

At Tobago, before the 11th, the weather was unusually boisterous, and the wind variable; after that date, the trade-wind became reversed, as shown by the following table.

Meteorological Observations, Fort King George, Tobago, 1846.

Date.	Ther. Max.	Ther. Min.	Prevailing Winds.	Weather.	Quantity of Rain.
1846. Sep. 8	83½	79	S E, S W, very variable.	Cloudy, high wind.	0·01
9	83	78	E S E, S E, steady.	Hazy, with frequent and sudden strong wind.	0·01
10	82	78	S S E, S W, W, variable.	Heavy rain, boisterous, squally.	0·81
11	82½	79	E S E, S W, and W, variable.	Boisterous and squally.	0·07
12	80½	78	S W, S S W, and W, steady.	Very boisterous.	0·89
13	82	78	W, W S W, steady.	Boisterous, with occasional calms.	0·73
14	81½	79	W, S S W, steady.	Calm during rain; very squally intervals.	0·56

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At Barbados and the easternmost of the Antilles Islands, the wind blew southerly on the 11th of September, and did some damage. The storm moving northward, in the direction of Porto Rico, it blew as a gale, yet not very violently. As it advanced its force increased, until it became a tempest of a furious kind. Passing to the westward of Bermuda, it blew there a hard gale on the 17th and 18th September: with the centre a little to the eastward of Newfoundland, it did great damage to the town of St. John's in that island, and was felt as far as Long. 19° W., Lat. 50° or 51°, on the eastern side of the Atlantic. But it was not felt at the Shetland Islands, as far as I could learn by enquiry, and therefore probably had subsided, or moved in the more northerly direction of Iceland.

Extract from the Meteorological Report kept at the Central Station at Bermuda.

Date.	Hour.	Wind.	Force.	Weather.	Bar.	Ther.	Remarks.
1846.							
Sep. 11	Noon	S E	6	b c p q	30·14	84	
12	,,	S E by E	5	b c m	30·10	87	
13	,,	S	5	c m	30·00	86	Squally, and barometer
,,	P.M. 4	S W	6	c m p u	29·93	86	falling.
,,	,, 9	S W by S	6	c p q l t	29·88	83	
14	A.M. 1	S by W	7	c l p q	29·85	..	
,,	,, 6	S W by S	7	c p q	29·81	84	
,,	Noon	S W	6	c p q	29·93	85	
,,	P.M. 5	W	7	c p q	*29·80	83	
15	Noon	N W	2	b c	29·87	84	
16	Noon	S	2	c m p	29·86	86	On the evening of the
17	A.M. 6	S E by E	6	c m p	29·87	80	16th, the sea breaking
,,	,, 9	S E	6	c m p q u	29·92	78	heavily on the south side.
,,	Noon	S S E	5	c m p q	29·93	79	Morning of the 17th,
,,	P.M. 9	S by E	8	l o p q t u	29·80	81	wind S.E., and a heavy
18	A.M. 4	S S E	10	o p q	29·65	..	swell of the sea coming
,,	,, 6	S by E	10	o p q	29·60	82	from the S.
,,	,, 8	S	10	o p q	*29·58	80	Afternoon of the 18th,
,,	,, 10	S by W	10	o p q	29·60	79	a heavy swell coming from
,,	Noon	S S W	8	m o p q	29·66	82	the W. and N.W.
,,	P.M. 6	S W by W	7	c m p q	29·80	81	
19	A.M. 8	W	5	c m p	29·98	78	
,,	Noon	W by S	..	b c m	30·03	83	

Barometer oscillating.*

* The oscillations of the barometer were also remarked on board a ship not far from Bermuda.

By referring to the figure in Chapter IV., page 36, intended to assist in explaining the direction in which the undulations raised by gales in the northern hemisphere roll on, the above remarks on the swell of the sea will be found to coincide with that figure.

The place where the Medway hove-to, was Lat. 27°.46′ N., Long. 73°.26′ W., at noon, on the 16th of September.

The following, with a few other suggestions, which I drew out and printed in 1842, for the use of Bermuda trading vessels, have since been embodied in the 15th edition of Blunt's American Coast Pilot.

Sailing from England to Bermuda.

On a ship leaving England for Bermuda, instead of steering a direct course for the destined port, or following the usual practice of seeking for the trade-winds, it may be found a better course, on the setting in of an *easterly* wind, to steer west; and if the wind should veer by the *south* towards the *west*, to continue on the port-tack if it should not blow too hard, until by changing the ship could lie its course.

Sailing on curved courses when meeting revolving winds.

If the wind should continue to veer to *north*, and as it sometimes does even to the *eastward of north*, a ship upon the starboard tack might be allowed to come up with her head to the westward of her direct course. On both tacks she would have sailed on *curved lines*, the object of which would be, to carry her to the westward against the prevailing wind and currents. There is reason for believing, that many of the revolving winds of the winter season originate within the Tropics; and that ships seeking for the steady trade-winds, even further south than the Tropic at that period of the year, will frequently be disappointed. How near to the Equator the revolving winds originate in the winter

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season, is an important point not yet sufficiently observed. The quickest voyage from England to Bermuda, therefore, may perhaps be made by sailing on a course composed of many curved lines, which cannot be previously laid down, but which must be determined by the winds met with on the voyage. This principle of taking advantage of the changes of revolving winds, by sailing on curved lines, is applicable to high latitudes in both hemispheres, when ships are sailing westerly.

Sailing from North America to Europe.

If a ship be prepared to sail from a port in North America for Europe or the eastward, at a time when a revolving gale is passing along the North American coast, it will be the southern half of the gale, which will be a fair wind for the ship sailing. She need not wait in port for the wind to become west, but might sail, if it did not blow too hard at the time, as soon as the first portion of the gale had passed by, and the north-east wind is veering towards north. The north wind will veer towards the westward as the storm proceeds northerly, and by remaining in port, a portion of time in which the wind blows fair would be lost.

Ships which leave the North American ports for Europe, and overtake gales, will sail into them on that side in which the wind blows northerly, and they will have the wind upon the *port side*. The progression of most of these gales being north-easterly, ships in such a position might be expected soon to fall into the southern or hinder half of the gale in which the wind blows westerly. By keeping within this portion of the gale's circuit, if it should not blow too hard, they would accompany it in its course, which would greatly accelerate the voyage.

Instead of the compass alone being the guide for the ship's track, the height of the barometer should also be taken into account; for that would show, by falling, when a ship is approaching the gale's centre, and by rising when she is in risk of losing the fair wind. The many rapid voyages which have been made from America to the north of Europe, are now explained to have happened, from ships continuing to sail on in that quadrant of progressive whirlwind gales in which the wind blows south-west.

Christoval Colon.

The Christoval Colon is an example of a ship having sailed from New York and passed across the front of an advancing whirlwind gale, and then heaving-to. The more this ship could have been made, with safety to herself, to go ahead towards the south-east, the further she would have drawn from the centre of the storm. The following narrative is taken from the *New York Tribune* newspaper.

"The Christoval Colon, which sailed from this port early in January for San Francisco, when a few days out, encountered a gale, the consequences of which are graphically described in the following letter from Captain Coffin, communicated to us by Messrs. Spofforth and Tileston.

"'Ship CHRISTOVAL COLON, Feb. 17, 1849,
Pernambuco, W. 88 miles, Lat. 88° S., Long. 33°.30′ W.

"'I deem it my duty to inform you, as early as possible, of our position and situation. On the 9th January a gale commenced from S. S.W., the ship running E.N.E. under a close-reefed main-topsail and reefed foresail. At 5 P.M. it being unsafe to run longer, hove the ship to, head S.E. by E., under staysail and close-reefed main-topsail. At 10 P.M. fore-topmast staysail and mizen-staysail blew to pieces; the gale still increasing, with a fearful sea running, the ship's deck filled with water forward, so that she could not raise her head. I called all hands, and went forward, and began to throw overboard everything we could get at or handle, but up to our necks in water, and a little of every-

Hove-to on starboard-tack.

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thing washing about; the darkness of the night, the violence of the gale, all combined, rendered our efforts of little avail: still, now and then, we could cut the hoops of the provisions, and let it find its own way overboard, and knock-in the head of one of the water-casks; but even this small service to relieve the ship had soon to be given up, to attend to things of still greater moment: about this time the steering davit gave way, and left the helm loose. At 12, the gale still increasing, the main-topsail split, the sheets parted, after the parrel which confines the yard to the topmast, and the main-topsail-yard was now making a right angle with the mainmast, the tops snapping to pieces, sounding like a thousand coach whips: soon after, the foretopsail blew out from under the gaskets, and set up with the main ones. By this time it had got to be so bad, that we could not move about the decks; we lashed ourselves to the weather-rail, to wait the result betwixt this violent hurricane and one of the finest sea-boats I ever saw; and while laying there on our beam ends, her mainyard occasionally touching the water, made me despair of her ever coming up again; in fact, I could not see how she was ever to come out of it; every lurch I expected to hear the crash of the fall of our masts; but our rigging was new, and happened to be well set up the day before leaving New York, or else we could not have got through the gale.

"'During all the time, the passengers, although all fully aware of our situation, never opened their lips, but behaved with as much coolness as sailors. Between three and four o'clock in the morning the wind shifted to N.W., and what with rain, wind, thunder, and lightning, I could not make a person hear me at the top of my voice, with my mouth close to his ears. After 4 the gale broke, and I now began to hope to save the ship. At 6, I went below, for the first time in thirty-nine hours. During the forenoon the sea began to get a little more regular, and we secured our maintop-yard; but the ship being under bare poles, she kept her decks filled with water all the time, and I found, if I lay there in that situation, without any sails, she would tear herself to pieces before another night.'"

CHAPTER XV.

GALES OF HIGH SOUTHERN LATITUDES.

We cannot hope to trace gales into high latitudes south of the Equator, with the same accuracy as in the Northern Atlantic, because there are yet comparatively few ships navigating the southern seas. There is now, however, sufficient information, when taken collectively, to warrant the conclusion, that the extra-tropical gales of southern latitudes move in counter direction to the extra-tropical gales of northern latitudes.

A very violent storm is described by Captain Sir George Grey, and is alluded to by Mr. Thom, as having occurred at Dorre Island, Western Australia, Lat. 25° S., Long. 113 E., in which the wind shifted suddenly from S. E. to N.W. If the chart of the Rodriguez Hurricane be applied to the position of Dorre Island, so that the degrees of *latitude* be made to coincide, that chart will serve to explain the nature of the storm described by Sir George Grey, and it would indicate that it came from the northern parts of Australia.

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Judging by analogy from the storms traced in the Northern Atlantic, such gales as that at Dorre Island might be expected to change their direction to the south, and to recurve to the south-east, between the twenty-fifth and thirtieth degrees of latitude; and it would appear, as far as can be gathered from exact observers on the subject, that they do so. Captain

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Wickham, R.N., who commanded H. M. ship Beagle, whilst surveying the west coast of Australia, makes the following remarks on the winds there:—

Captain Wickham.

"May is the month in which the winter weather fairly sets in, and it rarely happens that the middle of this month passes without the rains having commenced. This season seems to vary but little as to the time and manner of setting in; it is ushered in by blowing weather from about N.N.E., the wind gradually veering round to the westward as it increases in strength. The first of this weather usually lasts from a week to fourteen days, then comes an interval of fine weather, generally of a fortnight's duration, and sometimes a month; after which the rains set in more constant, and the intervals of fine weather are shorter: this weather lasts until October, and at times throughout that month.

"During the intervals of fine weather the climate is delightful, and the country has a fresh and pleasing appearance; land and sea breezes are as regular as in summer, with the exception that the latter are much more moderate.

"The north-west gales that occasionally occur during the winter months, on the southern parts of the west coast of New Holland, are probably felt as far north as Sharks Bay. They blow with great violence, and are accompanied by dark gloomy weather and rain. It is then unsafe to be near the land, as the gale that commences at N.N.E., invariably veers to the westward, making a lee-shore of the whole line of coast, and between W.N.W. and W.S.W. blows the hardest.

"Fortunately these gales give ample warning,—the barometer always foretells their approach, and generally begins to fall three or four days before the commencement of the gale; besides which, there are other never-failing indications of a northerly wind, such as the change of the current, which (owing to the prevailing southerly winds) usually sets to the northward, but runs strong to the southward during northerly winds, frequently preceding them, and giving more timely notice than the barometer.

"A rising of the water is likewise a certain prognostic of a northerly wind, and has been invariably noticed at Swan River to precede all gales from that quarter; this, of course, can only be observed while at anchor on the coast.

"Another, and perhaps equally certain, sign of approaching

bad weather, during the winter season (and which is almost certain to be from the northward), is the strength of the north-east winds. As it has been observed, that when the land winds blow strong, particularly from the north-east, and the sea breezes are light, with a falling barometer, a gale from the northward will follow. Perhaps these latter remarks are only applicable to that distance from the shore, where a ship will be within the influence of the land and sea breezes; but as I conceive the limit of that distance to be full thirty miles off shore, a notice of such a symptom of approaching bad weather may not be altogether useless. I am of opinion, that land winds are at times felt as far off shore as the edge of soundings, which is not less than thirty miles, and generally between that and forty.

Lat. 30°. 25′ S.

"In latitude 30°.25′ southward, and sixty-five miles from the land, soundings were got from the Beagle with 185 fathoms of line, upon a coral bottom. Between Swan River and Houtmans Abrolhos, soundings may be had at a greater distance from the land than off any other part of the west coast.

The north-west gales are of longer duration, in the latitude of Swan River and south of that, than they are to the northward. They do not appear to be entirely confined to the winter months, as I am told that a very heavy one was experienced at Swan River early in March, 1832; and on the 13th of December, 1839, the Beagle experienced a strong breeze from the northward, while at anchor in Gages Road, in consequence of which, it was considered necessary to let go an extra anchor.

"As it may be satisfactory to know more particularly the progress of these gales, and the effect they have upon the barometer and sympiesometer, I give the details of two that were experienced in her Majesty's ship Beagle,—one at Swan River, in the beginning of June, 1838, the other at Houtmans Abrolhos, in the beginning of May, 1840. They may be taken as fair criterions of the strength and duration of these gales.

"At Swan River, on the 24th of May, 1838, the wind was strong and squally from N.E. by N., sympiesometer standing at 30·74. During the day the oil commenced to fall, and continued falling slowly until the 30th, when it was 30·16; during the greater part of this interval the winds were light, generally from some eastern point in the morning, and going round the compass by north and west during the day; the nights were mostly calm; a heavy bank of clouds was collecting between N.N.E. and S.W., and the whole western horizon had a gloomy

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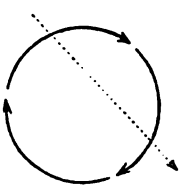
appearance. On the evening of the 30th, the water had risen considerably at the anchorage, and the stream ran to the southward. A fresh breeze also set in from N.E., and gradually veered to the northward as it increased in strength. On the 31st, it blew hard all day between N.N.E. and N.N.W., with dark squally weather; much lightning in the S.W., and heavy rain, that continued all night. On the 1st of June, the gale was at its height, and at 8 A.M. (the sympiesometer having fallen to 29·93) was blowing a hard gale, with heavy squalls and rain from N.W.; towards noon the wind veered to west, but still blew very hard. The sympiesometer now began to rise, and in the evening the wind was W.S.W., and had moderated considerably; the weather was also clearer, although heavy clouds still hung on the western horizon."

The gale described above, as veering from N.N.E. to W.S.W., implies the passage of a whirlwind gale with a south-easterly progression.



"The next morning (the 2nd) the sympiesometer had risen to 30·26, but this was much too sudden a rise (0·33 in 24 hours) to allow us to suppose that the favourable change in the weather was to be of long continuance. During the day the oil began to fall again, and the wind veered to W. and N.W.; and on the 3rd blew harder than ever, with heavy rain, thunder, and lightning, and with the exception of occasional intervals, when the wind moderated, this weather continued until the 10th. The wind during this time was variable, between N.N.W. and W.S.W. Sympiesometer between 29·81 and 30·16, falling with the north-west winds, and rising as the wind veered to W. and W.S.W."

The repeated fall of the barometer with a N.N.W. wind, and its rise as the wind veered to W.S.W. implied here, would indicate the passage of a succession of revolving winds moving towards the E.S.E.

"This gale, which may be said to have been of ten days' continuance, caused a heavy sea upon the coast: the oldest residents at Swan River said they had never experienced so heavy a sea before. On the 10th, the glass commenced to rise steadily,

and the weather was fine, with light variable winds, until the Beagle sailed on the 20th.

"Owing to the security of Owens Anchorage, and the good quality of the bottom, the Beagle rode out this bad weather, without causing the slightest apprehension to any one on board; but had a merchant vessel been in Gages Road, in all probability she would have added one more to the list of wrecks that have already done too much in prejudicing strangers against the Swan River settlement.

"The gale of May, 1840, at Houtmans Albrolhos, commenced in a similar manner with that already described, but being in a lower latitude, was of shorter duration, and the indications did not precede it such a length of time, still they were in every respect similar.

"This gale commenced on the 2nd of May, in the evening, and lasted until the evening of the 4th.

"On April the 29th, the barometer stood at 30·17 (having been some days steadily high); it then commenced to fall, and on the evening of the 2nd of May was 29·86; during this interval, we daily experienced strong E.N.E. and N.E. winds, they generally commenced after midnight and lasted until noon. A bank of clouds was also collecting in the N.W., and there was occasional lightning in that quarter. The early part of May (the 2nd) was nearly calm, and there was a heavy bank of clouds between N. and S.W. After noon, a light breeze sprang up from N.W., which gradually freshened, and during the night the barometer fell 17-hundredths.

"At sunrise, on the 3rd of May, there was a fresh breeze from N.N.W., and the weather had a very dull and gloomy appearance, the wind increasing rapidly, and by noon it blew a heavy gale at W.N.W.; the barometer had fallen to 29·58, at which it continued until midnight, when the wind drew to the southward of west, and the mercury began to rise. The gale continued unabated, with squalls and rain until noon of the 24th, although the barometer had been rising since the previous midnight. In the afternoon the wind moderated, and the weather became fine.

"From this it would appear that the barometer gives ample warning of an approaching north-west gale, as it had been falling nearly four days before the commencement of the bad weather; this alone ought to be sufficient to put a man upon his guard, if near the shore. Between the 29th of April (the first day of the

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fresh north-easterly winds) and the 3rd of May (when the gale was at its height, and the wind began to draw to the southward of west) the mercury had fallen 6-tenths. The change of current did not precede the wind, but changed with it. When the gale was strong from N.W. and W.N.W., the current ran a knot an hour to the S.E., and when the wind changed to S.W., it ran with the same velocity to the N.E."

An extract from the log of H. M. ship Beagle will be printed here, in order that the veerings of the wind on the south-western coast of Australia may be shown in detail.

Extract from the Log of H. M. Ship BEAGLE, *at single anchor, Houtmans Abrolhos.*

H.	K.	F.	Courses.	Wind.	Force	Weather.	Sym.	Ther.	Remarks.
A.M.									May 2, 1840.
1	..	..	.....	Calm					
2	..	..	.....	.....	0	b m	28·44	70	
3									
4	..	..	.....	.....	..	....	28·44	70	
5									
6	..	..	.....	.....	..	b c	28·44	69	
7									
8	..	..	.....	.....	0	b	28·40	72	Employed as requisite.
9									
10	..	..	.....	.....	..	....	...		
11									
12	..	..	.....	.....	..	....	28·26	78	
P.M.									
1	..	..	Standing	N West[by]	..	....	...	..	1.30, weighed, and
2	..	..	to the		..	....	28·20	79	made all plain sail on
3			north-						port-tack to light va-
4	..	..	ward	.....	..	....	28·36	77	riable airs.
5									4.5, tacked.
6	..	4	East	West	..	....	28·40	74	5.10, shortened sail,
7	..	5	N E						and came-to with
8	..	6	.....	.....	5	b v	28·34	72½	small bower in 24
9	..	5	E N E	W by N					fathoms; veered to
10	..	5	.....	.....	6	b c	28·30	72	60 fathoms; double-
11	..	6	N E						reefed the topsails
12	..	6	.....	N W	5	b c q	28·28	70	and furled sails; down topgallant-yards.
									Midnight.
A.M.									May 3, 1840.
1	..	6	East	N W	..	....	...	..	6.45, weighed, and
2	..	6	.....	.....	4	c q m	28·22	68½	made sail under
3	..	4							double-reefed top-
4	..	4	.....	.....	5	b c q	28·18	68	sails, reefed mainsail,

Extract from the Log of H. M. Ship BEAGLE—*continued.*

H.	K.	F.	Courses.	Wind.	Force	Weather.	Sym.	Ther.	Remarks.
A.M.									May 3—*continued.*
5	...	4	Standing to the						main-trysail, fore-sail, and fore-top-mast-staysail.
6	...	...	westward,	.....	..	....	28·15	70	7, split fore-top-mast-staysail, shifted ditto.
7			and working to windward						8.40, tacked.
8	...	...	.....	.....	6				9.45, tacked.
9	...	...	.....	.....	..	....	28·12	72	10, up mainsail; tacked occasionally, working to windward.
10	...	...	.....	N N W	7	b c m q	28·12	74	
11									10.40, shortened sail, and came-to with best bower, in 25 fathoms, veered to 65 fathoms; furled sails, struck topgallant-masts.
12	1	3	S S E	.....	7	c q p d	28·08	74	Noon.
P.M.									
1	1	6	S E by S	N N W	8	o c	...	..	Heavy squalls, with rain.
2	1	6	.....	W by N	9	c o q p	28·10	65	1, veered to 72 fathoms on best bower.
3	1	6	.....	.....					2, let go small bower, and veered to 84 fathoms on best bower.
4	1	6	.....		9	c r q	28·06	67	
5	1	6	.....	W N W					
6	1	6	S E	.....	8	c q r	28·10	67	
7	1	5							
8	1	5	.....	.....	9	b c m q l	28·11	67	6, veered on small bower cable.
9	1	4	S E ½ S						
10	1	2	.....	.....	8	b c q r	28·11	67	Midnight.
11	1	2							
12	1	2	S E by E	.....	8	b c q d	28·10	66	
A.M.									May 4, 1840.
1	1	3	E S E	W by N					10.30, veered to 6 fathoms on small bower.
2	1	2	.....	.....	8	b c q l	28·12	67½	
3	1	2							
4	1	2	E by S	West	8	b c q l	28·24	66½	
5	1	2							
6	1	2	E N E	W S W	8	b c q m	28·28	68	
7	1	2							
8	1	2	N E	S W	8	b c q m	28·24	67	
9	1	2	N E by N						
10	1	2	.....	.....	8	b c q p d	28·34	67	
11	1								
12	1	..	.....	.....	8	....	28·36	67	
P.M.									
1	1	2	North	S S W					No remarks.
2	1	2	.....	.....	4	b c q	28·34	67	
3	1	2							
4	1	...	.....	.....	4	b c q	28·38	69	
5	...	8							
6	...	8	N N E	S W	4	b c q	28·48	67	
7	...	8							
8	...	8	.....	.....	3	b c	28·43	68	

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Extract from the Log of H. M. Ship BEAGLE—*concluded.*

H.	K.	F.	Courses.	Wind.	Force	Weather.	Sym.	Ther.	Remarks.
P.M.									May 4—*continued.*
9	..	9							
10	..	7	North	.....	3	b c	28·50	68	No remarks.
11	..	7							
12	..	7	.....	.....	3	b c			
A.M.									May 5, 1840.
1	..	5	N E	W S W		....	...	..	Daylight, unbent
2	..	5	.....	.....	3	o c	28·52	68	sheet cable, and fid-
3	..	4							ded topgallant-mast.
4	..	3	.....	.....	3	c o m	28·52	68	6, hove up small
5	..	3							bower.
6	..	3	.....	.....	2	b c v	28·54	68	8.20, shortened in
7	..	3							cable on best bower.
8	..	2	.....	W N W	2	b c v	28·50	66	8.40, crossed top-
9	..	3	N N E						gallant-yards.
10	..	..	Working	Variable	..	....	28·54	67	9.20, weighed and
11			to						made sail.
12	..	..	windward	Westerly	3	b c m	28·52	69	10, calm; shorten-
									ed sail, and came-to
									with small bower in
									14 fathoms.
									10.50, weighed, and
									made sail; tacked as
									requisite; working
									to windward.
									Noon.

"The west coast of New Holland is at times visited by sudden squalls, resembling hurricanes; as I was told by the master of an American whaler, that in March, 1839, when in company with several whalers off Sharks Bay, he experienced very bad weather, which came on suddenly without having given any previous warning, but it was not of long continuance: the gusts of wind were very violent, shifting suddenly to all points of the compass. Some of the ships suffered considerable damage, in loss of top-masts, &c., others in sails, but all more or less. I think the first squall was from north-east, off the land.

"The American whalers that resort to the west coast of Australia, are upon different parts of it at all seasons of the year; their range is between the parallels of 10° and 50° of south latitude. In the summer they fish to the southward, and at that season visit Swan River and King George Sound for refreshments, but during the winter months they are rarely to the southward of Sharks Bay. Numbers are to be met off the north-west Cape.

"Between the parallels of 40° and 45° they meet much bad weather, as it is generally blowing strong with a heavy sea; but between 45° and 50° the weather is much more settled and finer. November is said to be generally the finest of the summer months, the winds are mostly moderate, and the weather more settled than at other periods.

"Two gales that were experienced by the Beagle in November, 1837, between the islands of St. Paul and Amsterdam and Swan River, will serve to show the different effects upon the barometer, by gales from opposite quarters, one being from north-west and the other from south-east.

"On the 1st of November the barometer stood at 29·90, having been gradually rising for some days previous to that, and the wind had been fresh between north and west. After 8 P.M. on the 1st the mercury began to fall, and on the 2nd the wind was strong from N.N.W.; barometer falling all day: during the night it blew a heavy gale, and the barometer fell to 29·34. On the morning of the 3rd the wind veered to the westward, and the mercury began to rise, the weather also became more moderate, and gradually fine.

"On the 8th of the same month the barometer was 30·05; at 8 P.M. with fine weather, wind S.E. by E., it then commenced to fall; and at 8 P.M. on the 9th was 29·80, and blowing a heavy gale at south-east, which continued all night, and until 8 P.M. on the 10th, at which time it became more moderate, and the barometer began to rise."

Sir J. Ross.

After leaving Christmas Harbour in Kerguelen Island, Lat. 48°.41′ S., Long. 69°.3′ E., in H.M. ship Erebus, for Van Dieman's Land, in July, 1840, Sir James Ross says:—

"The rise of the barometer on the 27th July to thirty inches, which is remarkably high for those latitudes, was followed at 8 P.M. by a gale from N.W. of twelve hours' duration. The increasing gale on the 28th July, reduced the sail to close-reefed main-topsail and foresail, which had become necessary to keep the ship before the following sea: this gale continued all night with 'a heavy *cross sea;*' much lightning to the eastward; meteors in great numbers darting about in all directions, and the whole aspect of the sky proclaiming a disturbance of the atmosphere of an unusual character. The barometer descended rapidly."

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At 4 A.M. of the 29th, the barometer stood at 28·88, and it continued to fall on until 3 P.M., when it was at 28·29, its lowest point. The gale had by that time abated considerably; but the account states:—

"So great was our reliance on the barometer, that we kept the ship under snug sail, and every way prepared for whatever might happen; and soon the dense accumulating clouds gave notice of the tempest which shortly followed. We however escaped it with but little damage, by the steadiness of our men who were steering, and by keeping the vessel directly before the wind; although the seas broke into our ship over both quarters, flooding our decks to the depth of more than two feet, and obliging us to knock out the ports to let the water run off, and relieve her of its weight. The mountainous sea, before which we had been scudding, *was quelled for the time* by the force of the wind, whilst the tops of the waves were driven completely over us in sheets of water; but the violence of the hurricane was soon to expend itself. Beginning at N.N.W., in an hour and three quarters the storm had abated to the strength of a common gale at W., and in that short space of time, the mercury in the barometer rose nearly half an inch. During the night both wind and sea abated."

See pages 115, 118.

Wind from N.N.W. to W.

Sir James Ross's narrative goes on, and states:—

"Gale followed gale in quick succession for several days, and indeed, with only brief intervals of more moderate weather. Whenever the wind veered to the *northward of west*, it was invariably accompanied with thick weather and snow showers. Cold weather and a clear sky as certainly prevailed with the *south-westerly gales*, the *barometer* also always *rising with the latter*, and *descending with the former*.

"On the 4th of August, at 8 P.M., it was down to 28·433, with only a fresh breeze; but a gale, which followed throughout the next day from the south-west, raised it more than an inch, before it abated at 8 A.M. on the 6th, when we were again favoured with a few hours of pleasant weather."

At noon on the 12th of August, after sighting the south-west Cape of New Holland, the wind increased suddenly and violently, and this storm is described as such as no canvas could withstand.

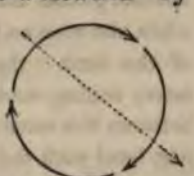
At 10 P.M. the barometer stood at 28·16, and then began to rise, but no abatement in the hurricane could be perceived until after midnight, when it moderated gradually, and shifted from N. to W. On the barometer, Sir J. Ross again makes the following remarks:—

"At noon, the 14th March, 1841, we were in Lat. 62°.42′ S., Long. 156°.51′ E. The mercury in the barometer at that time had attained the unusual height for these latitudes of 29·5 inches, at which it stood steadily until midnight, when the wind shifted to the *north*, accompanied by a thick fog, when it fell again as rapidly as it had risen, until at noon the following day it had reached 28·8 inches. We had so often before this time experienced such sudden oscillations of the barometer, that we were in consequence prepared to expect the sudden and violent squall, which, however, came on so furiously, as hardly to afford us sufficient time to close-reef our topsails and furl all other sails; it was of only four or five hours' duration, and had the good effect of clearing off the fog. * * * We made all sail as the wind gradually abated, but it had raised a high, short, irregular sea, in which the ships rolled and pitched uneasily: with difficulty we kept our heads in the right direction until 8 P.M., when it fell perfectly calm, and the swell took complete command of them."

Barometer.

The following is an abridged account from Captain Sir James Ross's second volume of his Voyage to the Southern Seas, page 165.

The gale here described was met in Lat. 65°.48′ S., Long. 157°.36′ W. The manner in which the wind veered from north-eastward to south-westward by north and west, as the barometer fell and rose again, is indicative of a revolving gale moving with a south-easterly progression, thus—



"16*th January*, 1842.—The wind having died away, a perfect calm prevailed; during the night, the swell from the westward greatly increased, and the pack being quite close and heavy, our ship sustained at times some severe blows from the ice, while the *rapidly-descending barometer* warned us of an approaching

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gale. Towards the evening of the 17th, the sea had gained such a height, that our eight-inch hawsers were not strong enough to hold us to the heavy floe, snapping one after the other so fast, that we had scarcely time to replace them with ropes of larger size. The wind had increased to a gale from the north-eastward, and blew violently throughout the night and during the forenoon of next day, but it had the effect of subduing the westerly swell, and of driving us towards the south-west water.

Gale setting in at N.E.,

"18*th January*.—The wind greatly moderated at 5 P.M., but at midnight the westerly swell increased, as the wind veered to the north-west, and it was found impossible to hold on any longer by the floe.

and

"19*th January*.—All our hawsers breaking in succession, we made sail on the ships, and kept company during the thick fog by firing guns. At 9 P.M. the wind suddenly freshened to a gale from the northward, and compelled us to reduce our sails to a close-reefed main-topsail and storm-staysails: the sea quickly rising to a fearful height, breaking over the loftiest bergs, we were unable any longer to hold our ground, and were driven into a heavy pack under our lee. Soon after midnight our ships were involved in an ocean of rolling fragments of ice, hard as floating rocks of granite, which were dashed against them by the waves with so much violence, that their masts quivered as if they would fall at every successive blow. Hour passed away after hour, without the least mitigation of the awful circumstances in which we were placed: the storm gained its height at 2 P.M., when the barometer stood at 28·40. At 4 P.M., although the force of the wind had somewhat diminished, yet the squalls came on with unabated violence, laying the ship over on her broadside, and threatening to blow the storm-sails to pieces; fortunately they were quite new, or they never could have withstood such terrible gusts. At this time the Terror was so close to us, that when she rose on the top of one wave the Erebus was on the top of the next: the deep chasm between them was filled with heavy rolling masses; and as the ships descended into the hollow between the waves, the main-topsail-yard of each could be seen, just level with the crest of the intervening wave, from the deck of the other. At midnight the wind suddenly shifted to the westward, when the snow, which had been falling for hours, cleared away, and the swell began to subside.

veering by the north,

to west,

"21*st January*.—The wind changed to S.W., the swell subsiding, and the weather moderating to a fresh breeze."

and to S.W.

I reprint the following remark in order that attention may be directed to that portion of it printed in italics.

Captain Ross, 2nd vol. page 281.

"*9th September*, 1842.—A storm came on soon after noon the next day from the south-west, which continued with little intermission, and accompanied by snow and rain, but varying in direction between south and west: as might have been expected in such a tempestuous ocean, and at a period of the year corresponding with the boisterous month of March in our latitudes, we encountered during our passage from the Falkland Islands to Cape Horn very severe weather, *the gales usually commencing in the south-west, veering to the west, and generally, as in the North Atlantic Ocean, ending in the north-west.*"

I have not been able to obtain a sight of any of the log-books of either the Erebus or the Terror for 1842. Sir John Ross may have met gales moving from east to west, which this mode of veering from S.W. to W. and N.W. in the southern hemisphere would indicate. It is the barometer which enables us to separate one gale from another: the barometric observations made on board those two ships are therefore necessary, before these exceptional cases can be fully established.

The atmospheric pressure is found to be less in high southern latitudes than in high northern latitudes.

Sir J. Ross' Table.

TABLE of Mean Pressure, and the Amount of Atmospheric Tide in different Latitudes south of the Equator, as given by Captain Sir James Ross, from hourly observations made between the 20th of November, 1839, and the 31st of July, 1843:—

Lat.	Pressure.	Atmospheric Tide.
At the Equator	29·974 ..	·047 at sea.
13°. 0′ S. ..	30·016 ..	·060 „
22°.17′ ..	30·085 ..	·053 „
34°.48′ ..	30·023 ..	·052 } Cape of Good Hope and Sydney.
42°.53′ ..	29·950 ..	·050 Van Dieman's Land.
45°. 3′ ..	29·664 ..	·031 at sea.
45°. 8′ ..	29·469 ..	·040 } Kerguelen and Auckland Islands.

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Lat.		Pressure.		Atmospheric Tide.
51°.33′	..	29·497	..	·032 Falkland Islands.
54°.26′	..	29·347	..	·022 at sea.
55°.52′	..	29·360	..	·027 Cape Horn.
60°. 0′	..	29·114	..	·024 at sea.
66°. 0′	..	29·078	..	·016 „
74°. 0′	..	28·928	..	·016 „

In high latitudes, north of the Equator, the mean pressure has been found to be—

Lat.		Pressure.		
51°.28′	..	29·872	..	at Greenwich.
66°.11′	..	29·798	..	at Winter Island.
69°. 0′	..	29·770	..	at Igloolik.
74°.45′	..	29·870	..	at Melville Island.

Captain Fitzroy.

Captain Fitzroy, in his narrative of the voyage of the Adventure and Beagle, describes the winds off Chiloé and the Chonos Archipelago, from the 42° to the 45° of south latitude, precisely in counter terms to what I found suited for Bermuda. He says, off Chiloé the winds make a "round turn." In his Appendix, No. 19, will be found the following remarks:—

"There is much less difference between the climate, the prevailing winds, and the order in which they follow; the tides and the currents on the outer coasts of Chiloé, and at the west entrance of Magelhaens Strait, including the intermediate coasts, than persons would suppose, who judge only by their geographical positions. North-westerly winds prevail, bringing clouds and rain in abundance: south-westers succeed them, and partially clear the sky with their fury; then the wind moderates, and hauls into the south-east quarter, where, after a short interval of fine weather, it dies away. Light airs spring up from the north-east, freshening as they veer round to north, and augment the store of moisture which they always bring. From the N. they soon shift to the usual quarter, N.W., and between that point and S.W. they shift and back, *sometimes for weeks before they take another turn round.* When the wind backs (from S.W. to W.N.W., &c.) bad weather and strong winds are

See foot of page 2.

sure to follow. On that coast the wind never backs suddenly, but it shifts with the sun (with respect to that hemisphere) very suddenly, sometimes flying from N.W. to S.W. or S. in a most violent squall. *Before a shift of this kind there is almost always an opening or light appearance in the clouds towards the* S.W., *which the Spaniards call an eye* (ojo), *and for that signal the seaman ought to watch carefully.* As the sudden shifts are always with the sun, no man ought to be taken aback unexpectedly; for so long as a north-wester is blowing with any strength, accompanied by rain, so long must he recollect *that the wind may fly round to the* S.W. *quarter at any minute.* It never blows hard from E.; rarely with any strength from N.E.; but an occasional severe gale from S.E. may be expected, especially about the middle of winter (June, July, August). In the summer, southerly winds last longer and blow more frequently than they do in winter, and the reverse. The winds never go completely round the circle, they die away as they approach E.; and *after an interval of calm, more or less in duration,* spring up gradually between N.E. by E. and N. Heavy tempests sometimes blow from W.N.W. to S.W., and those winds blowing directly on shore are most to be guarded against. As to the tides, they are simple and uniform in the extreme. High water, at full and change, takes place within half an hour of noon from Valdivia to Landfall Island, and the rise of tide is everywhere on the outer coasts, within those limits, nearly the same; namely, from four to eight feet. In the offing, no stream of tide is anywhere discernible, and even close to the land it does not exceed one knot, or at most two knots, an hour. On this extent of coast, what little current is felt sets southward, except during or before strong or lasting southerly winds. Its influence is, however, but trifling upon a ship out of soundings.* A heavy swell from the westward drives in upon all the coast. *A barometer* is invaluable."

Storm's eye.

See page 272.

See page 245.

In Captain Fitzroy's Appendix, No. 28, he states—

"About the end of March the northers, as they are called, begin to remind one that fogs, heavy and frequent rains, thick gloomy weather, and strong winds, often trouble the southern coasts of Chiloé.

"During a part of March, and throughout April,

"* By the term *out of soundings*, I mean in deeper water than 300 fathoms."

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May, and June, foggy weather is frequent; and although it is not often that a thick fog lasts longer than a few hours, a day, even two days, of continued thick fog is not an unknown occurrence.

"With northerly and north-west winds the sky is overcast, the weather unsettled, damp, and disagreeable. These winds are always accompanied by clouds, and usually by thick, rainy weather. From the north-west the wind in general shifts to the south-west, and thence to the southward. Sometimes it flies round in a violent squall, accompanied by rain, thunder, and lightning; at other times it draws gradually round. Directly the wind is southward of west, the clouds begin to disperse, and, as a steady southerly wind approaches, the sky becomes clear, and the weather healthily pleasant.

"A turn of fresh southerly wind is usually followed by a moderate breeze from the south-east, with very fine weather. Light variable breezes follow, clouds gradually overspread the sky, and another *round turn* is generally begun by light or moderate north-easterly breezes, with cloudy weather, and often rain.

"This is the general order of change. When the wind shifts against this order, or backs round, bad weather with strong wind may be expected.

"Lightning is always a sign of bad weather: it accompanies or precedes a change for the worse, which, however, is usually a prelude to clearing up. Squalls are rare, *excepting at the shift from N.W. to S.W.* already mentioned. From the westward (S.W. by W. to N.W. by W.) the wind does not usually, if ever, blow nearly so strong as from N.W. to N. or from S.W. to S."

Storm's eye.

The ojo, or eye, as the Spaniards term the light

appearance in the clouds before a shift of wind, and which Captain Fitzroy calls "a signal which seamen ought always carefully to watch," seems frequently to occur at the centre of a revolving storm. An interesting instance is given in Mr. Piddington's fifth Memoir of its being observed in the middle of a very hard gale in Lat. 38° S., Long. 22° E., by a French ship called Le Paquebot des Mers du Sud. By the published account of the veering of the wind and the fall of the barometer, that ship was scudding on the east side of a revolving gale south of the Equator. The gale was moving most probably in a S.E. direction, and faster than the ship; the wind changing from N.E. to N., to N.N.W., to W.N.W., and towards W. The barometer fell to 27·79 inches English. The ship seems to have been struck by a whirlpillar very near the centre of the storm.

Mr. Piddington states—

"That Captain Saliz, who was upon deck, says, that at the moment of being taken by it, everything was in a blaze of light (no lightning is marked before on the log, and he says that there was none worth noticing), like a sort of meteor, for there was fire everywhere, though nothing was burnt. The fire had no electrical characters. He distinctly saw the lightning cross the main-topsail in zig-zags, when the sail disappeared; some fragments were left, but these had no traces of ignition. He says further, that the whirlwind turned from *left to right, outwards*. The vessel's head was about N.E. while on her beam ends, and it was blowing so furiously that it was impossible to look to windward. A very remarkable fact is, that *while all around the horizon was a thick, dark bank of clouds, the sky above was so perfectly clear that the stars were seen*, and *one star shone with such peculiar brilliancy above the head of the foremast, that it was remarked by every one on board*. The barometer, which, as stated, was at noon 27·5 Fahr., or 28·00 English, was at 6 P.M. at 27·3 Fahr., or 27·79 English, and at midnight again at 27·5 Fahr. The gale after the whirlwind was at W.N.W., veering to W., and remaining there till fine weather on the following day,

Whirlpillar.

Storm's eye.

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when the American ship Thomas Perkins passed them, with royals and studding-sails set. A remarkable fact also was the warmth of the weather. Captain Saliz did not notice the thermometer, but says that every one found it quite warm.

"No person on board was any way affected by the lightning. *The sea, after and during the vessel's lying over, was much diminished, and was a sheet of foam.* After righting, she steered E. by S. and E.S.E. with the wind."

See pages 115, 118.

Captain B. J. Sulivan.

From Captain Bartholomew James Sulivan, R.N., who was employed making a survey of the Falkland Islands, I received some account of the winds there. He says:—

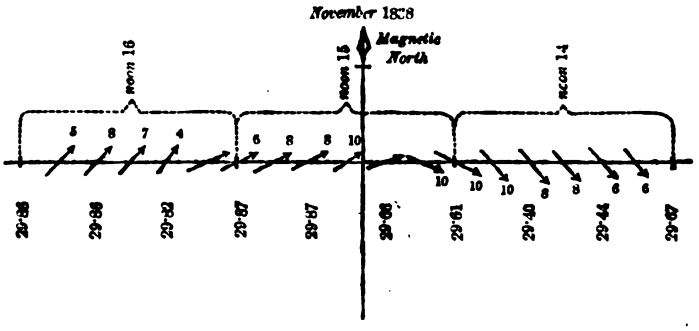
"We had, on an average, during the five months I was there, as many days of gales as of moderate weather; the usual round being this:—The gale commenced at north or north-west, and after having blown for some hours from those quarters, drew round to *west*, and then *south-west* and *south*. But there were some gales that blew for several days from south-west without having commenced at the northward of west. Some also commenced at north-east, and blew strong from that quarter for several hours before they drew round to the westward."

Captain Sulivan added sketches of some of these gales in the form of a peculiar kind of register, not easily copied, but which expresses distinctly the manner of veering of the wind, its force, and the oscillation of the barometer during the passage of the gale.

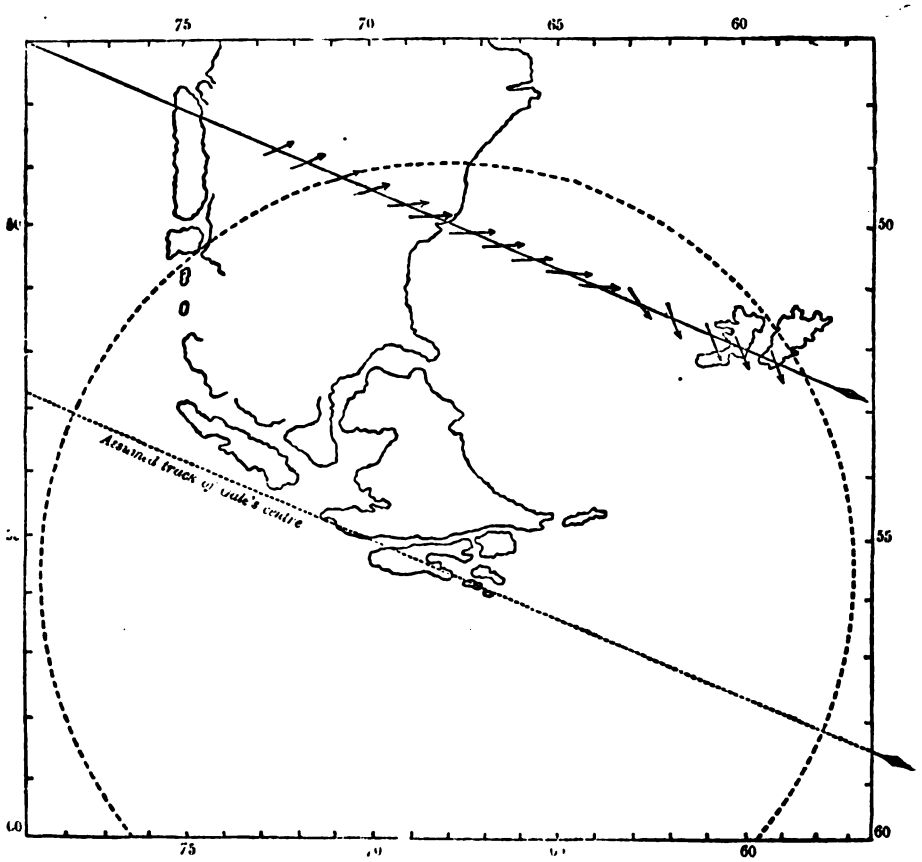
He also gives an example of a south-west gale, blowing without veering, which seems to correspond to the north-west winter gales of the northern hemisphere; but the height of the barometer is not given.

Four examples are copied below. The first was a gale which lasted three days, namely, the 14th, 15th, and 16th of November, 1838; setting in at about N.W., and veering by the W., ended about S.W. The numbers marked at the arrow heads, for periods of four hours each, denote the wind's force by the scale

at page 15; and below these are written the fall and rise of the barometer. CHAP. XV.



I have endeavoured in the next figure to show the extent which this gale may have embraced; and,



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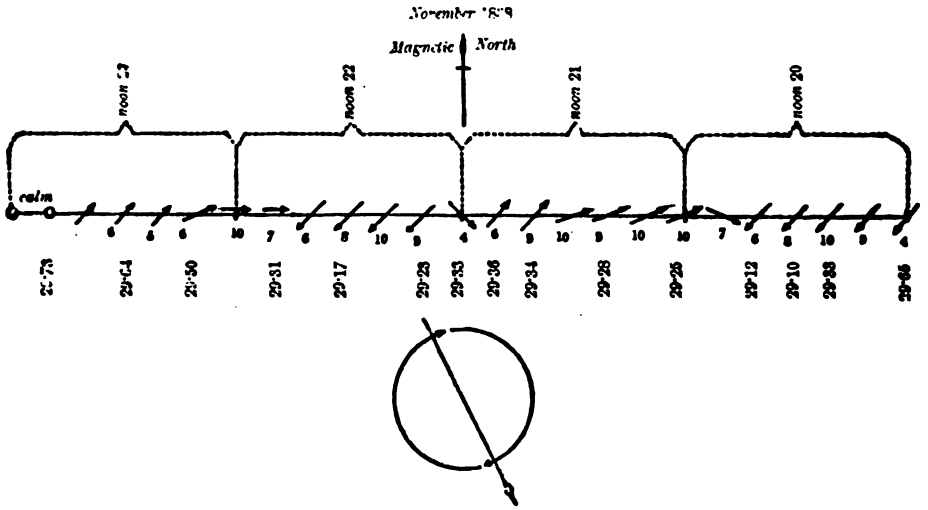
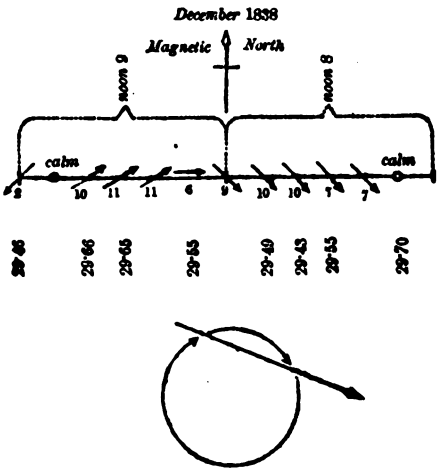
allowing for variation, the direction in which it was moving, as if it had been a circle. But, no doubt, rotatory gales of vast extent, in high latitudes, must be subject to great irregularities from many disturbing causes, which perhaps hereafter may come to be better understood.

Captain Sulivan's next diagram contains two separate gales, following closely upon each other, each lasting two days. These two gales were moving S. S. E., as indicated by the spear drawn across the small circle below.

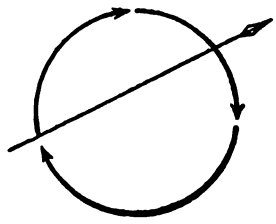


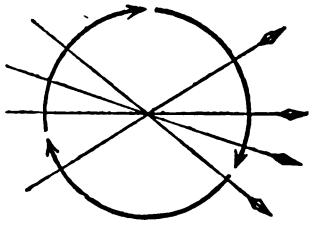
The fourth gale, marked in force as a storm, was moving in the same direction as the first.



Captain Sulivan adds:—

"Some of the heaviest of the gales finished at S., and even at S.S.E., and in these quarters they were generally furious. When this was the case, I suppose the storm must have come from the S.W., and passed over us in the manner shown by the spear in the annexed figure, and must have blown first from N.W., and afterwards drawn rapidly round to S.W. and to S.; and this was the case. Is it likely that the storms would come from so many different directions? for, if my ideas are correct, they must come from all parts between S.W. and N.W., thus—"





These observations, made in the Falkland Islands, in Latitude 51° S., accord with observations made in the

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British islands, in Latitude 51° N.; for it is found, that gales over the British islands come in the counter directions, namely, from all quarters between N.W. and S.W.

Captain Moody, Royal Engineers.

Captain Moody, of the Royal Engineers, who was Governor of the Falkland Islands, gave me an account of the winds there, which entirely agrees with Captain Sulivan's description. Both concur in describing the climate as milder and very different from what it was supposed to be by the accounts of early navigators. Although gales are very frequent, the climate is a dry one; the winters for the latitude are mild, and the summers cool.

The reason for the climate being dry may be owing to nearly all the gales there coming over the high land of South America, where much of their vapour would be condensed. But the gales which pass over the British islands from the westward encounter no land, and probably the most of them coming from the S.W. are nearly saturated with vapour from the latitude of the Azores.

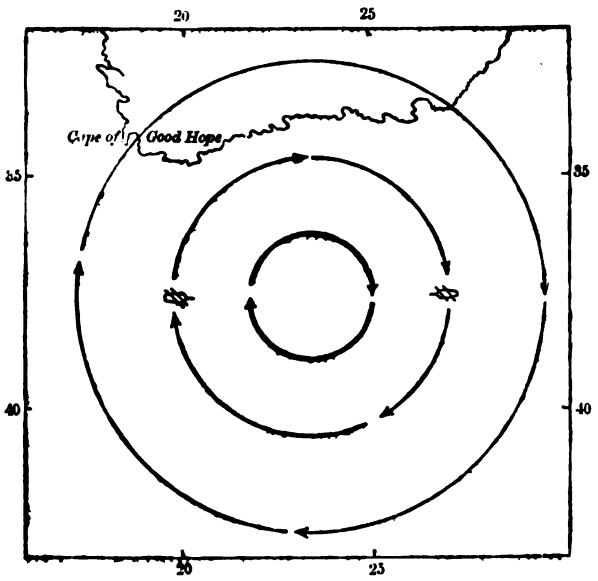
See fig. page 395.

With the exception of the Culloden's storm at page 243, we are almost confined in extra-tropical latitudes of the southern hemisphere, to reason from data furnished by single ships.

Sailing into gales.

When ships, *south of the Equator*, meet and sail into a whirlwind gale, of which the centre is on the same latitude with themselves, the wind will be on their *starboard sides*, whether they happen to be sailing east or west, and their heads at the time will point to the storm's centre.

The next figure will show, that the ship sailing eastward, would find a fair wind by keeping away



before the south wind, which might be expected to veer to west. But, although the ship sailing westward, by keeping away before the wind, would be likely to have the north wind veering to east, she would most likely run in front of the gale; because, in that latitude, it might be expected to have a south-easterly progression. By tacking, and standing to the north-east, she would probably avoid the strongest part of the gale, but she might expect to have the wind veering towards west.

The Nereide frigate (see figure, page 243), sailing eastward from the Cape of Good Hope in 1809, met the Culloden's storm in this manner, and might have saved her masts, by changing her course to the northward. The Harrier is supposed to have foundered in the same storm, by having followed the Racehorse, Nereide.

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also sailing eastward; and might have been saved by putting before the wind, or coming to the wind on the port-tack.

Neptune. The ship Neptune, which is shown in the diagram at page 35, as sailing into a storm south of the Equator, had the wind on the starboard side. By a mistake in the second edition of the Law of Storms, this drawing was reversed, which showed the ship on the wrong tack.

Windsor. In Mr. Thom's work on Storms, at page 117, it is said, that the ship Windsor, on the 17th of February, 1838, on her voyage from India to England, met a gale in Lat. 27° N., Long. 56° E., and had the wind veering from N.E., to N.N.E., to N., to N.N.W., to N.W., and S.W. Mr. Thom remarks, "On this occasion the Windsor appears to have crossed behind the storm, and run through its northern half. This case of the Windsor appears nearly similar to that of the Huddart (see figure, page 243), which ship met the Culloden's storm after it had recurved and had the wind at N.N.W., veering to N.W. and W. by S.

Atlas. What befel the ship Atlas in 1831, is an example of a vessel scudding round the front of an advancing gale, in latitude 26° south, and failing in the attempt. At that period the nature of the gales of the southern hemisphere was not understood. This ship met the southern half of the revolving gale, where the wind blew E. N. E. and scudded on, until compelled to shorten sail, just at the place of greatest danger. Then the ship broached-to.

Such, no doubt, are the circumstances under which many ships have foundered.

Extract from the Log of the Ship ATLAS, FRANCIS HUNT, *Commander; three days from Mauritius, on her Voyage to England (reduced to Civil Time).*

"*Tuesday, Dec. 13th,* 1831.—Lat. Observed, 24° S.; Long. 55°.28′ E.

"P.M. 1, steady breeze and fine weather; wind E. by N.; course W. by S.

"Midnight, increasing breezes; going six knots; in royals and topgallant studding-sails. Shortening sail.

"*Wednesday, Dec. 14th.*—A.M. 4, squally; going seven knots; in lower studding-sails.

"10, strong breezes, with heavy rain; in topgallant-sails, and double-reefed the topsails.

"Noon, strong gales, with a heavy sea.

"Lat. by Account, 26°.10′ S.; Long. by Account, 54°.11′ E. Lat. 26°. 10′ S.

"P.M. Gale increasing, with constant and heavy rain; wind E.N.E.; course W.S.W. and S.W.; weather thick and close; sea confused and high. (Ship quite tight.) Gale increasing.

"2, looking still worse. Barometer indicating stormy weather. Prepared to make all snug and secure on deck and aloft. Close-reefed the topsails, furled the mizen-topsail, down royal yards; ship *scudding* before the gale very well. Close-reefed topsails.

"At 4 P.M. the gale had obtained such strength as to render it difficult and dangerous to run before it. The sea running high, broke over our quarters repeatedly, stove in a part of the stern timbers, filled the cabins, and much water got below. *It became necessary to shorten sail if possible.* In the attempt the ship broached-to against the helm to starboard, the foresail being in the brails, and the men on the yard to furl it. No time was to be lost. Orders were given to cut away the topsails and foresail, which eased the ship and saved the masts, which must otherwise have gone by the board. The sea high, making a constant breach over her; much water constantly on the decks. (Ship quite tight.) Ship broached-to. Men on the yard. Cut away sails.

"About 6 P.M. the storm became terrific; the masts stood tottering like willows; we looked to their going every moment.

"About 7 P.M. the E. *wind abated, and the sky broke open from* N. *to* E. *This lasted but a short time,* when the gale or hurricane became as furious from N.W. to S.W., accompanied with lightning and rain; this change of wind threw the ship into a Storm's eye.

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perilous situation, having the main body of the sea from the larboard lee-quarter to the larboard beam; stove in the quarter gallery. The bulwarks and rails, lower booms, and many articles, were carried off the deck by the sea breaking into us; the quarter frame much shook, cabins filled, and much water got below by the skylight hatch. The cutter filled and broke her davits; obliged to cut her away to clear the ship's counter.

Wind shifted.

Ship leaking.

"About 9 P.M. discovered a considerable leak in the larboard counter that was filling the lower deck faster than men could bail with buckets. Determined upon lightening the ship abaft; set the pumps to work; found we gained upon her; left off throwing out the cargo. The carpenter was ordered to cut away the lining and lockers on the larboard quarter below decks, to come at the leak. When opened, the stream which rushed into the ship was frightful; could not come at the source. Carpenter ordered to cut away the same above the deck as he had done below. The water was then discovered to come in through the lower arch board of the stern; supposed it to have been split by the sea striking heavily abaft. Kept the pumps going constantly, and gained upon the leak all night. Towards midnight the weather moderated and cleared up; lay-to all night until daylight; called the hands to clear and replace the wreck. We fear that much sugar is damaged in the after part of the ship, from the quantity of water that came in at the stern frame after the wind changed and threw the ship's stern to the sea. The day ends with fine weather, with a heavy sea running; wind from W. to S.W. and S. S.W.

Daylight, 15th Dec.

"Lat. Observed, 26°.54′ S.; Long. Observed, 52°.37′ E."

Sutlej.

The ship Sutlej affords another example of the manner in which ships south of the Equator, meeting whirlwind gales, of which the centres are on the same latitudes with themselves, have the wind on their *starboard sides* when sailing into danger. The figure at page 399 will show how, by wearing and standing to the N.E., this ship would have steered from the gale's centre. The following is an extract of the log-book of the Sutlej, obtained from the owner, Mr. Green. The Sutlej experienced a second gale on the 4th of April.

See fig. page 399.

Log of the East India Ship SUTLEJ, *from Madras towards the Cape of Good Hope, reduced to Civil Time.*

H.	Courses.	K.	F.	Wind.	Remarks.	
A.M.					March 31, 1848.	
1	W S W	7	..	Variable	A.M. Fresh breeze, and cloudy.	Sutlej, with royals set.
2	S W ½ S	7		from	At 4 tacked to the northward.	
3	S W by W	7		Northward	Set top-gallant-sails, royals, and flying-jib.	
4	.....	6		to		
5	North	4		Westward	At 8 tacked ship to the southward.	
6	.....	3			At 9 sudden shift to the S.W.; in	
7	.....	3	4	W N W	royals, flying-jib, and braced round.	
8	.....	5			At 10 set royals and flying-jib.	
9	S W	5	4		Noon, fresh breeze and variable; in	
10	W N W	6	..	S W	royals and flying-jib.	
11		3			Distance, per log, 155 miles.	
12	N W.	6	..	Westerly	Lat. 35°. 39′ S., Long. 25°. 08′ E., Course S. by 3° W., Distance, 137 miles. Bar. 29°, Ther. 65°.	
P.M.						
1	N N W	5	..	Moderate	At 1 P.M. sent the royal-yards down.	Weather threatening; shortening sail.
2	.....	6		and fine.	Bar. 29·63.	
3	.....	6		Fresh	Threatening appearance from N.W.	
4	.....	6	..	breeze.	At 5 tacked to S.W.	
5	S W by S	6			At 8 breeze freshening, in top-gallant-sails, double-reefed the topsails, reefed	
6	.....	7				
7	.....	7	4		mainsail, and stowed the jib; pumped	
8	.....	7			ship 13 inches.	
9	S S W	3			At 9 furled mainsail and mizen-top-sail, reefed and furled foresail.	Ship on starboard tack.
10	.....	3		Hard gale		
11	.....	1	4	from N W	Midnight, blowing a furious gale	
12	.....	1	4		from the N.W., with a tremendous sea rising.	
A.M.					April 1.	
1	Lying-to.				Battened the hatches down fore and	Battening hatches.
2	Ship's				aft, and secured them well; furled the	
3	head up to				fore and main topsails, and fore-top-mast-staysail; lying-to under mizen	
4	S W by W					Hove-to.
5	off S S W				trysail.	
6					At 2 blowing a perfect hurricane,	Storm.
7					mountainous sea running, ship labouring much; at 2.30 the sea stove in the	
8						
9					starboard-quarter gallery; at 3, finding	
10					the sea increasing, and rolling in over	
11					all, filling the decks, ship staggering	
12					under it, and clearing herself with difficulty, decided upon bearing up; turned	
P.M.					the hands out to make sail; while loos-	
1					ing main-topsail and foresail, and set-	
2					ting the fore-topmast-staysail, a tre-	
3					mendous sea struck her on the bow and	
4					broke the bowsprit close to the knight-	Bowsprit broke, and masts went.
5					heads; put the helm up, lowered mizen-	
6					trysail, and let fall main-topsail, but, be-	
7					fore the ship could pay off, the bowsprit	
8					came alongside, the foremast rolled	
9					over to leeward, the mainmast fell aft	
10					over the lee quarter, and mizenmast	
11					over the stern, all three going close to	
12					the deck, and taking three quarter-	

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Log of the East India Ship SUTLEJ—*continued.*

boats with them, and one gun. Considering the ship in danger from the wreck, commenced cutting away everything; ship rolling fearfully; a gang of soldiers keeping the pumps sucking and bailing out from between decks; the sea rushing in through one of the stern-ports, which had been stove in by the wreck, and also through the starboard-quarter gallery-door, and down poop skylight.

H.	Courses.	K.	F.	Wind.	Remarks.
A.M.					April 2.
1					Lost overboard from aloft, Butts, a. b.; Davy, a. b., lost his left arm; the boatswain, carpenter, and several men much hurt. Carpenter blocking stern-port and quarter-gallery up. At 5.30 the gale continuing with furious gusts, ship straining much in the upper works, and heavy sea rolling over all. At 6 succeeded in getting the wreck clear; soldiers constantly bailing out between decks, and pumping ship as required. At 10 weather moderating, ship still rolling heavily, and shipping much water. In clearing away the wreck, hove overboard seventy-one empty water-butts, and five casks of provisions.—N.B. Water on deck at the time, five butts. At noon sea going down, ship still labouring much. Lat. 36°.20′ S., Long. 23°.58′ E.
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
P.M.					
1	Ship's head Southward and Westward			Light to Eastward	P.M. Light airs, and swell going down; shipped a top-gallant spar for mizenmast, and set main-trysail on it; got the spare topsail-yard in board, and shears up for shipping it as a foremast; cut the hawser up for rigging.
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					Midnight, light airs, ship rolling heavily.
A.M.					April 3.
1					A.M. Daylight, shipped the foremast; down the fore scuttle, and set fore-top-gallant-sail as a foresail.
2					
3					
4					Got a rough top-gallant spar out for a bowsprit, put a reef in the jib, and set in.
5					
6					
7					Pumped ship every two hours at 14 inches.
8					
9					Lat. 36°. 3′ S., Long. 23°. 30′ E.
10					(Signed) Alfred Parish, Commander.
11					A. R. Oldham, First Mate.
12					T. W. Allen, Second Mate.

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In the Nautical Magazine for 1845 will be found an account of the voyage of the Albatross, a cutter of 75 tons, belonging to the Royal Yacht Squadron, in her passage from Van Diemen's Land to England, round Cape Horn. When in the South Pacific, and in Lat. 48° S., Long. 159° W., the master, Mr. J. M. Gill, remarks,

Albatross.

"It is here where the mariner may study and depend on the barometer. As regularly as the gale veered from the northward to the southward of west, so the column rose, and from the southward to the northward, the indicator was depressed." And it is added "that light winds, veering to the north and east, forebode the day of change."

Barometer.

On the 8th of February the Albatross experienced a gale which exemplified the above remark. Being a fast-sailing vessel, she seems to have overtaken the gale, and had the wind fluctuating between south-west and north-west. "The barometer continued to fall at the rate of one-tenth of an inch every hour for five hours, and sank to 28·28; the little vessel was rounded-to, with her head to N.N.E., the gale blowing N.W. and N. in squalls, thick, dark, and rainy." In twenty-four hours the barometer had fallen an inch and one-tenth. The figure in the next page represents the Albatross thus hove-to, on the port tack.

The N.W. gale continued to rage with fury until 6 A.M., when it suddenly changed to W.S.W., and blew with increased force. The heavy cross sea produced *by a sudden shift is described as all foam and spray.* The little vessel was then near the gale's centre; and here we have an example of that clear space in the heart of the tempest, the storm's eye. Mr. Gill adds,

Storm's eye.

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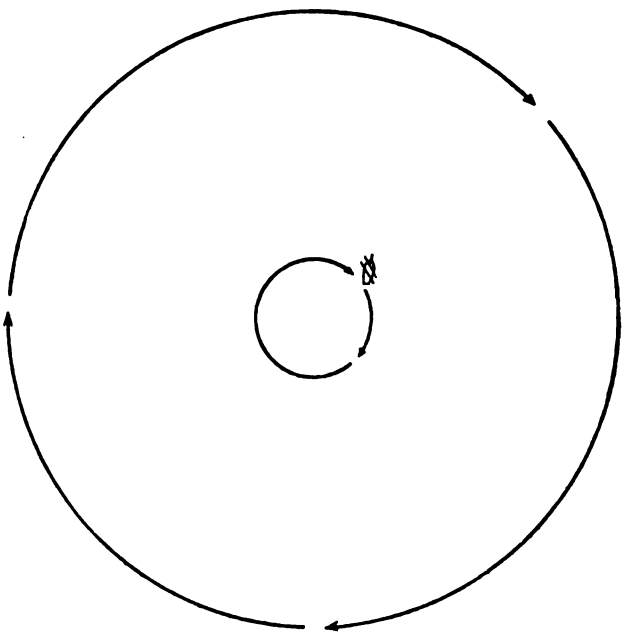
Albatross hove-to on port-tack.



"The sun, having been concealed during the day, *now shone out for a few minutes nearly in the wind's eye with fiery brightness,* some of us thought for the last time. *The small archway that opened to windward through dense masses of cloud,* served the purpose of a funnel, and forced the gale over us in gusts, every one of which appeared determined to tear away the few yards of canvas we had set, strong, stout, and new as they were."

See pages 115, 118.

The next passage seems to show that the wind changed quicker than the sea.

On port-tack, and coming up.

"The heavy cross sea *produced by the sudden shift was all foam and spray,* like a boundless tide-ripple, and for some time created an alarm for the worthiness of our little sea-boat; but nothing could have felt the change quicker than herself, coming round to it like an arrow. The *first cross roller* seemed bent upon our destruction, as she cut through it with her long, small, and sharp round bows, and bowsprit. As she was now end-on to such breakers, her plunge aft as she stood on end was truly frightful. Every dip brought about eight feet of her after part under water. It was now for us to remedy the plunge aft, as

every four or five minutes she settled down, the cross seas rushing over the whole after part, her bows having an extra elevation in the air. The stream chain, and other heavy weights, stowed under the after cabin, were removed into the main cabin; and this little alteration in her trim had an immediate effect upon her. The vessel became easy and lively; such seas as had formerly rushed over her abaft were now cleared with the greatest ease.

"As soon as I could leave the deck, which was about two hours after the change of wind, the barometer had ascended from 28·28 to 28·36; by midnight it rose to 28·66; but at 1 A.M. the squalls veered from W.S.W. to W., and the mercurial column became again depressed to 28·58.

"By 5 P.M. on the 10th the indicator showed 28·70, as the breeze veered gradually to the S.W., and we bore away before that kind of sea that no man would suppose we could live in."

Cape Horn.

Anson, in his voyage round Cape Horn in 1751, passed between Staten Land and Tierra del Fuego, on the 7th of March, O. S., and had scarcely cleared the strait when the weather suddenly changed, the wind shifting to the southward, and blowing in violent squalls. The Spanish squadron, under Pizarro, sent to intercept him, was at the same time more to the eastward; and next day, when about the latitude of Cape Horn, experienced a storm from N.W., of such violence as to oblige Pizarro to put back to Rio de la Plata. It is, therefore, probable that the two squadrons were, at the same time, within the compass of the same revolving storm. From that time forward, in his passage round Cape Horn, Anson seems to have met with a succession of winter gales of more than ordinary violence, which there is now every reason to believe were progressive whirlwind storms. Had he understood their nature, he would no doubt have been spared the very heavy losses his squadron suffered.

The winds met with in passing round Cape Horn,

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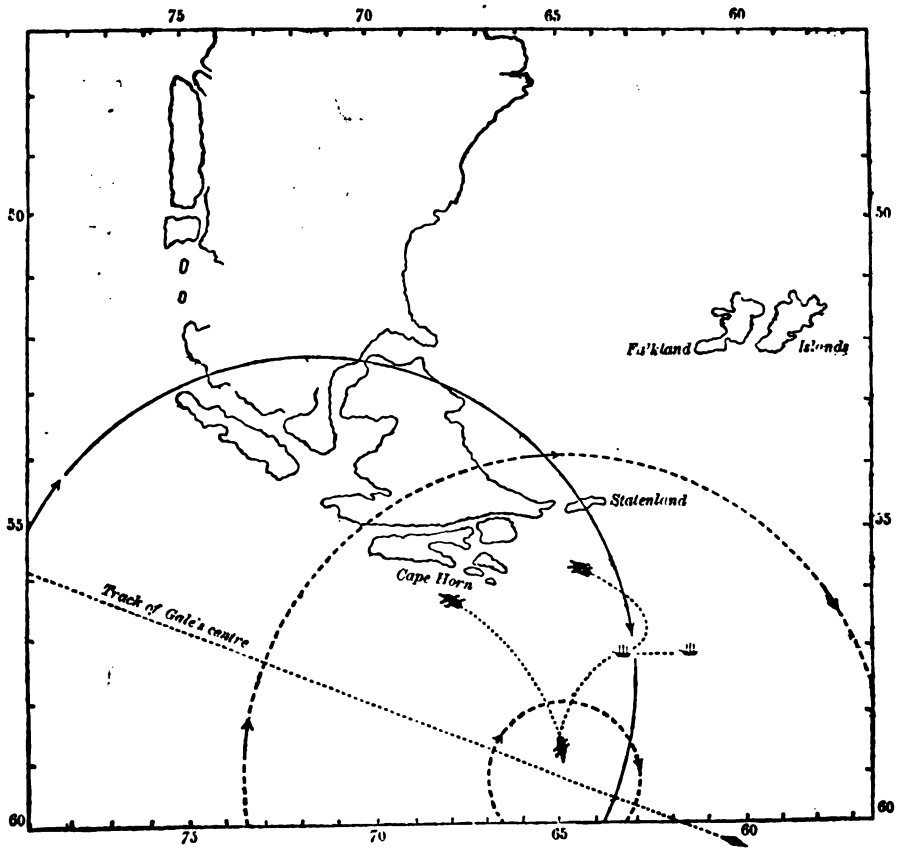
from the Atlantic to the Pacific, must vary, not only according to the degree of force of the gales, but will also depend upon the track a gale may be following, and the position of its centre with relation to the place of the ship.

Sailing west.

I do not presume to lay down any rule as to the best course to be followed, but confine myself to placing a figure here, which may assist seamen in considering under what circumstances, and at what times, they should change from one tack to the other, under warnings from the barometer, the swell, and the veerings of the wind.



This figure corresponds to the one printed at page 344, but with the movements reversed, in consequence of the counter-movement of gales in the southern hemisphere. The ship standing southerly, and on the starboard-tack, is shown as falling off, as a N.W. wind veers to W., and it is represented as approaching a gale's centre. The figure is equally applicable to the Cape of Good Hope and to Cape Horn.

The ship, standing northerly on the port-tack, is shown as coming up, as the N.W. wind veers to W. and S.W., and it is represented as sailing away from the storm's centre. A third ship is added, in order to show the advantage which may be gained by standing on, with a N.W. wind veering to W., provided the weather is such as to warrant a ship standing on in the *southern hemisphere on the starboard-tack* during a gale.

What has been said regarding the application of the law of storms in high northern latitudes to North Atlantic voyages will, when reversed, apply equally to high southern latitudes; and the experience gained in sailing in the North Atlantic may be made useful for navigating the southern oceans.

The observations in Chapter XIV., page 374, upon ships sailing from North America towards Europe and the eastward, apply equally to sailing from the Cape of Good Hope to Australia, regard being had to the counter-movement of gales in the southern hemisphere.

Captain J. Erskine, R.N.

This mode of sailing was put in practice by Captain John Erskine, R.N., commanding H. M. ship Havanah, during a voyage from the Cape of Good Hope, through Bass's Straits to Sydney, which he made in the unusually short time of thirty-four days. It is stated in

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a Calcutta newspaper, that the Havanah purposely accompanied one of these progressive gales for five days, and made in that time 1185 miles. Captain Erskine well understands how to take advantage in sailing of the veerings of the wind, having studied for many years the theory of revolving winds.

Monsieur Bousquet.

After this chapter, on gales of high southern latitudes was in type, I received from Earl Grey a copy of a translation into French, of Mr. Piddington's Sailor's Horn Book for the Law of Storms, with notes by Monsieur Bousquet, at Mauritius. It is entitled *Lois des Tempêtes*, ou *Guide du Navigateur*.

The observations of Monsieur Bousquet confirm what I have here stated, on the recurving of gales in the southern hemisphere towards the south and south-east, and he has given instances of their south-easterly progression at the Cape of Good Hope as well as at the Island of Mauritius. The gales of the ship Sutlej are amongst these instances. He expresses an opinion, that the gales which pass the Mauritius are of greater extent than has been supposed.

See page 402.

Monsieur Bousquet's notes show, that the commanders of French vessels have begun to apply practically the knowledge gained on the law of storms.

CHAPTER XVI.

CONCLUDING CHAPTER.

On a review of all the facts collected and arranged on the subject of the revolving winds, this simple practical result is found, namely, that when ships meet a whirlwind gale, and are sailing towards the gale's centre, *north* of the Equator, they have always the wind on the ship's port-side; and when ships meet a whirlwind gale *south* of the Equator, and are sailing towards the gale's centre, they have always the wind on the ship's starboard-side, as the figure in the next page will show.

But when the first part of a revolving gale is overtaking a ship, it will be otherwise; for then the ship would be as if sailing from the storm's centre. This would be the relation of the ship to the wind, until the storm's centre had passed beyond the ship's place, after which the ship would be as if pursuing the gale.

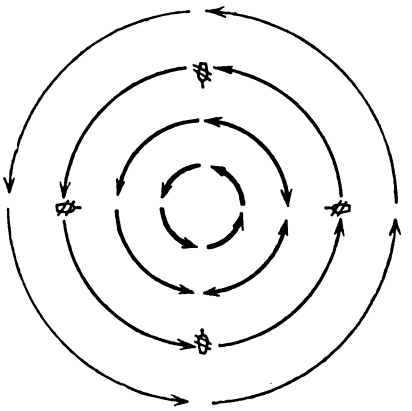
When the rapid changes of wind, at or near the centre of whirlwind gales, are generally understood, they will cease to take seamen at unawares. These sudden shifts account for ships which have been lying with their lee-sides buried under water, totally unmanageable and refusing to wear, frequently righting in the midst of a tempest.

It may be supposed, from an inspection of the chart

CHAP. XVI.

Northern hemisphere;

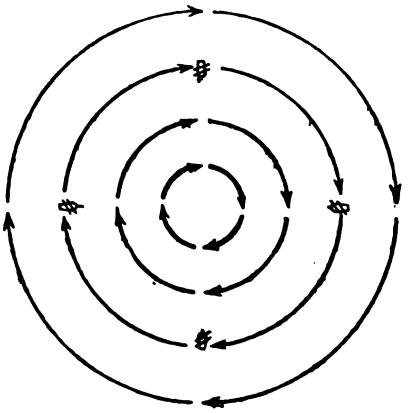
wind on ship's port side, when sailing into a gale.



EQUATOR

Southern hemisphere;

wind on ship's starboard side, when sailing into a gale.



of North Atlantic storms prefixed to the title-page, that all storms pursue a lengthened course before they subside. But the study of the Bay of Bengal storms would appear to show that there are whirlwind storms which subside not far from the place of their origin.

Since gales seem to be sometimes met with on the European side of the North Atlantic, moving with a south-easterly progression, the falling of the barometer

and the rising of the wind and sea, should be taken as warnings to wear a ship in time, and to place her on the starboard-tack, before the sails are carried away and she becomes unmanageable.

That opening, or diminution in the density of the clouds in the centre of a storm, which the Spaniards expressively call the storm's eye, is a very curious part of the phenomena of storms well deserving to be observed and studied.

The progression of the swell raised by storms is also a subject to be further observed, both at sea and on coasts.

Why gales do not "blow home."

An expression frequently used by mariners, as well as in books of sailing directions, is that gales in certain cases "*do not blow home.*" The reason for this is explained by gales being whirlwinds; and this explanation will be evident from inspecting the figures made to illustrate the storms of the Bay of Bengal.

Storm signals at Barbados.

In 1847 I had the satisfaction of establishing signals at Barbados to give warning of approaching hurricanes, and of publishing, at the same time, suggestions as to the direction in which ships should be steered when quitting Carlisle Bay at the setting in of a hurricane.

The following is a copy of the official notice alluded to:—

"A barometer is kept and registered at the principal police station at Bridgetown, Barbados, and notice will be given to the captain of the port when it falls. On the captain of the port rests the responsibility of causing signals to be hoisted, that the barometer indicates bad weather.

"One ball at the masthead of the signal-posts is to signify that the barometer is falling, and should be carefully watched.

"If the barometer continues to fall, and the weather appears threatening, a second ball will be hoisted at the masthead.

"As the indications of the weather become alarming, these

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two balls will be gradually lowered, until they are only half-mast high.

"As soon as the barometer begins to rise again, the two balls will begin to be slowly rehoisted, so as to be again at the mast-head when the barometer shall have risen one-tenth of an inch.

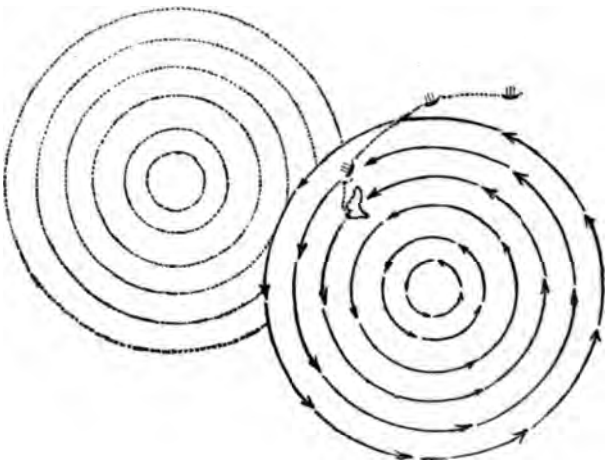
"When the barometer shall have risen two-tenths of an inch, then one ball will be taken off, and the other be left until the storm shall have passed over.

"Hurricanes being whirlwinds, the wind in the circuit of its revolution blows from every point of the compass within the circuit of the whirlwind. The veering of the wind is owing to the whirlwind's progress. Hence the reason why the trade-wind is often reversed during these tempests.

"Ships riding at anchor in Carlisle Bay, unless their commanders prefer to remain there, cannot put to sea too early after the first indication of a hurricane.

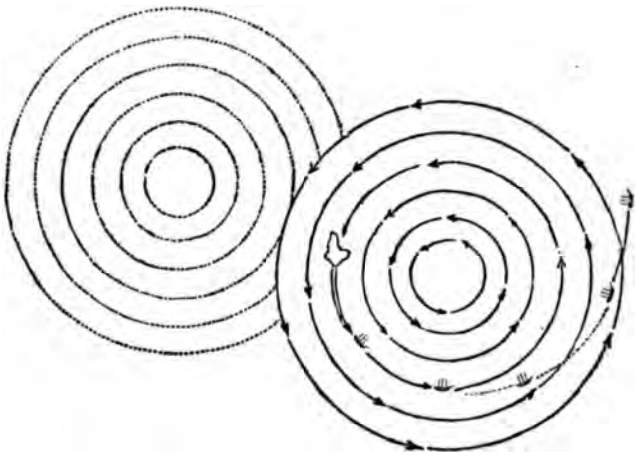
"When the wind veers from N.E. towards E., with a falling barometer, it may be expected to become S.E. and S.S.E.; and in this case the centre of the storm would be passing on the southward of the island.

"In the following figure, the centre of a hurricane, coming from the E.S.E. direction, and moving in the direction of St. Lucia, is supposed to be passing on the south side of Barbados:—



"When the trade-wind changes to N., and to N. by W., with a falling barometer, the wind may be expected to become N.W.,

and to veer to W., and perhaps even S.W. In this case the centre of the storm would pass over the island. Both these last cases will be understood by an inspection of the annexed diagram, in which the concentric circles, marked by continuous lines, are intended to show a hurricane setting in; whereas the dotted circles are intended to represent the position of the same hurricane, after having passed over Barbados:—



"In either case, ships remaining too long at anchor would be in danger of becoming embayed on a lee-shore.

"The hurricanes which have passed over Barbados, and of which we have any precise records, have all come from the eastward or south-eastward. When the centre is expected to pass on the northward of the island, or over the island, ships quitting Carlisle Bay should endeavour to run to the southward and south-eastward, by scudding in the first instance. But, when the centre is expected to pass on the southward or south-west side of Barbados, a ship should go to the northward, and come to the wind on the starboard-tack, otherwise it might sail into the vortex of the storm, as may be seen by referring to the first diagram. By keeping to the eastward, whilst the storm is moving to the westward, ships will sooner be out of a hurricane.

"The same rules, in some degree modified on account of the other windward islands forming a chain, apply also to them.

"The amount of damage done by West India hurricanes to the barracks and other public buildings has at different

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times been very great. The troops have often retired to sleep, quite unconscious that a hurricane was approaching, to be awoke by the falling of the buildings upon them. For the sake of public economy, barometers have now been placed at the principal barrack stations in the West India islands subject to hurricanes."

See fig. page 4.

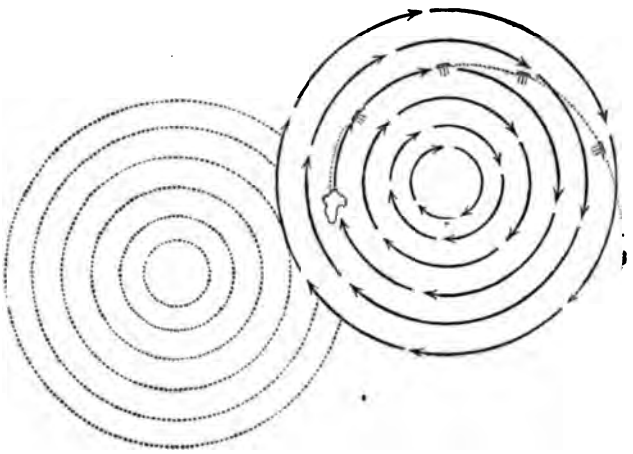
When a storm comes from the east, it will set in at Barbados with the wind at north. When it comes from the south-east, it will set in at Barbados with the wind at north-east. The north-east and the north sides of houses are, therefore, the sides which should be first barricaded, whilst the opposite doors and windows might with safety be left open. They should be barricaded in succession, according to the way in which the wind veers round. The same rules apply to the other windward West India islands.

Securing buildings against a hurricane.

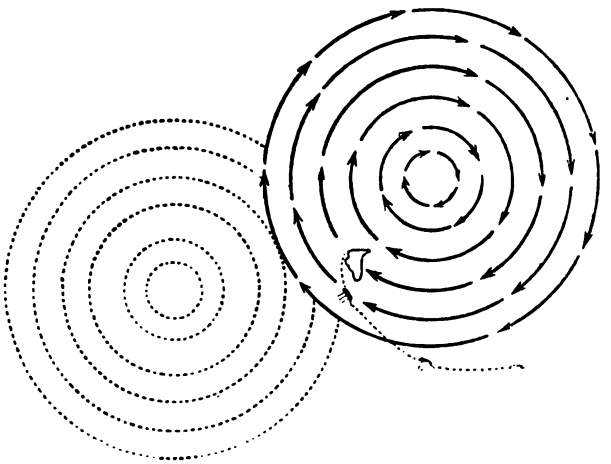
Putting to sea from Mauritius.

The last two figures made for Barbados, when reversed as given opposite, will serve to assist commanders of ships in considering the best course to steer on putting to sea from Port Louis, Mauritius, or from the roadsteads of the Island of Bourbon. In a note at page 68 of Monsieur Bousquet's *Lois des Tempêtes*, he speaks of the storm signals established at Barbados, and he publishes directions for steering ships which put to sea from Mauritius on the approach of a hurricane. On comparing these directions with the Barbados figures *reversed*, I find their accordance remarkable. But Mauritius and Bourbon lie in nearly seven degrees higher latitude than Barbados, and the gales which pass over the former islands, may therefore be expected to take a more southerly direction than these reversed figures represent. On that account, the preferable course for steering, will generally be towards the north, in a direction curving according

to the veering of the wind and movement of the barometer.



Centre passing south of Mauritius.



Centre passing north of Mauritius.

Log-books of ships.

In the Royal Navy, a ship's run is now kept in knots and tenths, instead of knots and fathoms; and the day is reckoned by civil time, instead of by nautical time. It would be a great assistance to the study of the winds if the practice of the Merchant Service con-

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formed in these particulars to that of the Royal Navy. The wind's force is inserted in a separate column of the log-books of the Royal Navy, according to the scale printed at page 15; and symbols to denote the state of the weather, as printed at page 16, are entered in another column.

It is much to be desired, for the sake of furthering the study of the winds, that all these improvements in the mode of keeping log-books should be adopted throughout the commercial marine. It is also very desirable that all ships' log-books should contain a column for noting observations upon the swell, which I have only found in the log-books of steam-vessels. The journals of ships at sea are assuming a great importance in the science of meteorology, which science seamen have a paramount interest in promoting.

The entries made in the log-books of ships during tempests are, no doubt from necessity, often few and brief. The most interesting records for study would be the state of the winds and waves, and the position of the ship, just at the moment of most imminent danger, when it cannot be written. But there is not the same reason for curtailing observations made on shore. The practice of recording the state of the weather at fixed hours only, is not applicable to the study of the variable winds. When there is no variation in the weather, a single observation during the day is all that is required. During the passage of gales and great storms, observations can scarcely be too copious; for then all changes of wind and of atmospheric pressure should be noted, and as many of them published as can conveniently be done.

The direction of the wind taken from ships' log-books I consider as meaning the magnetical direction; and the height of the barometrical column is given as reported without correction.

Storm tracks may influence climate.

The climates of different countries may be influenced by the storm tracks; and this is a very interesting part of the study of meteorology to be pursued. It has been observed, that when storms, which have been tracked to a distance over the sea, come in contact with land such as India, they most frequently cease to blow as regular whirlwinds, but often deluge the countries they pass over with rain. The Barbados Storm of 1831 was traced as a storm over the Gulf of Mexico, but only marked in the state of Alabama by very heavy rain. The moist climate of the west coast of England, and more especially of the west coast of Ireland, is no doubt in part owing to the many Atlantic whirlwind gales which impinge on these coasts.

The extreme dryness of other countries may likewise be in some degree owing to storms being arrested in their course by very high mountains. The Cordilleras of South America, lying eastward of Peru and also of the northern part of Chili, by arresting the course of whirlwind gales, may perhaps be one of the causes of the drought of these countries. In a similar manner, north of the Equator, the mountains of Abyssinia, by arresting the course of the gales which come from the southern part of the Arabian Sea, may be one of the causes why little or no rain falls in Upper Egypt; and the Himalayan Mountains, by arresting the progress of Indian storms, may make the countries which lie immediately to the north of them comparatively dry.

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Great value of the barometer,

It is impossible to overrate the value to the seaman of an instrument which will inform him of the changes in the atmospheric pressure over the place of his ship. The barometer is a measure of the atmospheric pressure, and should be regarded as nothing more. But that most valuable instrument has been brought into disrepute with many persons, by the makers themselves, from their practice of marking on the face of the instrument, indications of the weather not strictly correct.

and how instrument makers have brought it into disrepute.

If the index of the barometer were simply divided into inches and parts of inches, the public generally would soon acquire the knowledge of how the instrument measures atmospheric pressure, and how that knowledge assists in forming a judgment on what will be the probable state of the weather. By leaving the agriculturist to make his own observations on the consequences which follow from the alterations of the atmospheric pressure, he will come to much more just conclusions on the probability of the weather being dry, or of rain approaching, than by putting faith in arbitrary expressions too hastily adopted.

Aneroid barometer.

A new instrument of French invention, the Aneroid barometer, offers an advantage for nautical purposes, from its portability, as its size and form resemble a ship chronometer.

A new interest in the barometer will be given, even in the high latitude of the British Islands, to those persons who are in the habit of watching its fall, if they make a practice of comparing its gradual descent with the veering of the wind. And, if beyond the fiftieth degree of latitude the veering of the wind and great

atmospheric oscillations are found regular only in tempests, it is just at that time that the instrument is of the greatest practical value. When its true value comes to be generally understood, its use will not be confined to ships making distant voyages, but coasting vessels will carry it on board. Every fishing village should have its barometer. The Earl of Aberdeen has set an example worthy of imitation, by fixing a barometer where it may be observed by the fishermen on his estates.

All who may read these narratives of storms will, I think, be convinced of the impolicy as well as inhumanity of sending ships to sea too deeply laden. The overloaded ship, which cannot rise upon the waves in a storm, is in danger of being struck by a weight of many tons of water. Her seams open by degrees. As she becomes leaky she sinks deeper in the water, and then the difficulty of standing to the pumps increases. If the cargo be of greater specific gravity than sea-water, when the ship fills she must go down.

I have purposely abstained in this volume from speculating on the cause of storms, or upon the reasons why they revolve in opposite ways on opposite sides of the Equator; preferring to set forth, to the best of my power, the law they follow, and the practical end to be gained from the study of the winds. I hope others will be induced to continue the study of this subject; for I am deeply impressed with the great practical value of pursuing the investigation of the veering winds. I have endeavoured to show that the application of the Law of Storms should not be too rigorously applied in high latitudes, and yet that enough has been done to remove the im-

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pression hitherto entertained, that it is altogether hopeless to attempt any explanation of the Variable Winds. This study has already afforded to the mariner unlooked-for rules to guide him. Its tendency is to aid navigation, and navigation is the principal means of international communication and of commerce, which are the surest bonds of peace amongst nations.

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To face the Title-page—Chart showing the Central Tracks of Gale and Storms.

To face page 3—The Law of Storms.

To face page 15—Chart showing the Track of Two Whirlwind Storms.

To face page 39—Chart of the Bermuda Hurricane.

To face page 43—Plate of the Tracks of Two Storms, 28th November 1843.

To face page 323—Chart showing the Great Extent of Winter Gales.

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